POWER

Vol. 46 NEW YORK, DECEMBER 25, 1917 No. 26

A Few Words to the Beginner in Power-Plant Work

WHATEVER chain of circumstances led you to take up this work, you have entered a field of endeavor which is second to none in its opportunities for advancement. The requirements to be fulfilled before such advancement is possible, however, are not to be lightly considered. That is, the fulfillment of these requirements is not the work of a few weeks, nor even months. Years must be devoted—devoted in the strictest sense of the term—before such fulfillment is possible. Much of the labor will be mental. Not all of it—not by any means. If you do the right thing by yourself, in the years of apprenticeship which are to come, you will be physically tired just about as often as you are mentally fagged. For you are now engaged in an occupation that requires of the one who succeeds in it a close intermixture of those attainments that are the result of practical experience on the one hand and study on the other.

Your first years in the work will require, as one of the prime requisites for proper mastery, a thorough application to details—to matters that you may sometimes consider inconsequential and of slight importance. Let not that idea influence your course, for one of the most important points to bear in mind is that without a thorough grounding in these very details—these matters of seemingly small importance—it will be impossible to become proficient in the handling of the larger problems.

THE MARCH OF PROGRESS in the power field is the result of the application of theory to the facts brought out by experience. If we have not the facts, we have nothing substantial on which to build, and facts are obtained only by experience. More than once your fingers will be tender from the loss of skin, your hands seared and blistered. But the fellow who manages to skip all these undesirable experiences is losing where you are gaining. He is letting pass opportunities for personal observation that some day would serve him in a manner and degree not now thought of. Your time is coming, while his will never come!

Don't, however, in your efforts to accumulate a fund of wide and varied experiences, forget to keep after the theory—foresight—end of the game. Here is where you will begin to collect on your experience. Experience tells you what has happened, but theory will show you how to overcome the difficulties encountered in the past, how remedies for these difficulties may be applied.

WHEN you have erected a theory on a structure of experience, don't hide your deductions—bring them out in the light, no matter what your position in the plant may be. Initiative is what your employers are looking for—are willing to pay for.

You are engaged in an occupation in which there is a continual improvement and consequent change in the design and method of operation of the appliances which will come under your supervision as you progress in your chosen field. What is considered an efficient machine today may be supplanted tomorrow by one that is so far superior that the only logical thing to do will be to get rid of the old one and install the new. What is standard practice today may be totally out of date tomorrow. Human ingenuity is never satisfied, and the result is constant improvement. To keep up with these changes will require mental alertness of the highest degree. Cultivate the acquaintance of those who are engaged in the same occupation as yourself, in order that you may learn from them and they from you. Read assiduously the technical press which is devoted to the education and advancement of those in your field. Only by these means can you become an expert in your line and attain the mental satisfaction which is experienced by those who have aimed high and, by persistence and strict application to duty, have hit the mark.

Contributed by H. G. Gibson, Washington, D. C.

Methods of Cooling Transformers

By ARTHUR PALME
Transformer Engineering Department, General Electric Co.

Starting with the early dry type of transformer, which depended upon natural draft to dissipate the heat generated in its windings and core, the author discusses the different types of transformer tanks that have been developed to meet the ever-increasing size and changing operating conditions of transformers. A development which has made possible the modern 8000-kv.-a. self-cooling and the 14,000-kv.-a. water-cooled oil-insulated transformers.

WHEN electric energy is transformed from one voltage to another, a certain amount of this energy is lost and is not available as electric power. In other words, when such a transformation takes place, we have at the same time a second transformation; that is, a certain amount of the electric energy is transformed into heat energy. The generation of this heat is caused by three factors: First, by the losses in the iron (core loss); second, by the losses in the copper windings due to their ohmic resistance (copper loss); third, by the parasitic losses set up in the windings, the tank and other metal parts of the transformer (eddy losses).

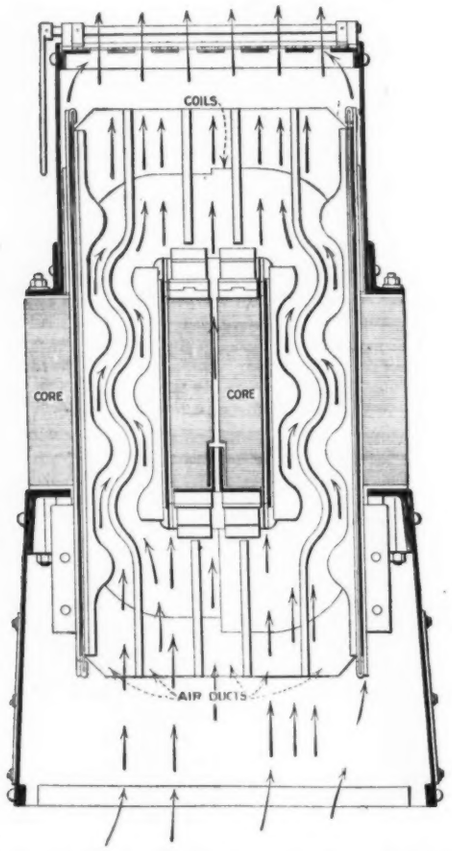


FIG. 1. SHELL-TYPE, AIR-BLAST TRANSFORMER

The iron losses depend only upon the induction and the frequency and are therefore, in a given machine, practically constant. The copper losses originate only in the windings and vary proportionally to the square of the current, hence their name, I^2R losses. The losses due to the eddy currents are usually small in a well-designed transformer. Measurements at no-load with a wattmeter give the core loss; the determination of the ohmic resistance of the winding and the normal current in the same will give the copper loss. The sum of both, or the total loss of the transformer, is the energy that causes the heating. In every transformer there is therefore, besides transformation from one voltage to another, a continual generation of heat, and it is necessary to find proper means of cooling in order to keep the temperature within reasonable, predetermined limits. The insulating material used in an air-cooled transformer is the limiting feature for the allowable heating. In cases where the voltage is very low, asbestos may be used to insulate the turns of the winding, and in such a case it might be possible to operate a transformer up to several hundred degrees C., as, for example, in some induction furnaces. In general, however, fibrous insulations are used and 105 deg. C. is about the highest permissible temperature.

The simplest and one of the earliest methods of dissipating the heat from a transformer was by natural air draft. The winding can be either of cylindrical or rectangular coil design and can usually be made with suitable air ducts to dissipate all the heat generated, provided the transformer rating is not more than about 100 kv.-a. at 60 cycles. It is possible to build transformers of this type with a larger output, but they usually necessitate such a large amount of copper and iron that the price becomes prohibitive. It is European practice to build and to use extensively transformers up to 150 kv.-a. and higher of the natural-air-draft types, sometimes with additional radiating surface gained by copper sheets inserted between the coils (Pichler's patent).

Far better results can be obtained when air is forced through the windings. The shell-type transformer with rectangular coils is especially suited and has been used mostly for this kind of cooling. Its coils, long rectangular windings, are placed vertically, air ducts are provided between them, as in Fig. 1, and the whole machine placed above a pit, where a blower maintains an air pressure of about 1.5 oz. Thus cool air enters the transformer at the bottom, is forced up between the coils and leaves as heated air at the top. By means of especially arranged dampers the amount of air can be regulated in proportion to the load. Air-blast transformers have been built and are in successful operation with an output of 10,000 kv.-a. three phase at 60 cycles with a temperature rise of 55 deg. C. under full load.

While it is possible to build air-blast transformers that will operate safely on voltages up to about 30,000, the continually increasing distances of electric transmission forced the designer to considerably higher potentials. Also it was desirable to install small trans-

formers with relatively low potentials out-of-doors on poles, where the conditions were not entirely suited for natural-draft or forced-draft cooling. The high insulating qualities and large heat-carrying capacity of oil fulfilled these requirements, and hence was developed the present-day oil-immersed transformer.

The determination of heat dissipation in an oil-immersed transformer is based upon two factors—the coil

FIG. 2. PLAIN CAST-IRON TRANSFORMER TANK

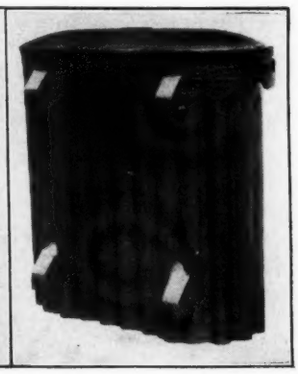


FIG. 3. CORRUGATED CAST-IRON TANK

radiation and the tank radiation. The winding has to have sufficient surface and proper ducts to give its heat up to the surrounding oil. The tank has to have sufficient surface to dissipate the heat from the hot oil into the cooling air. It is not intended in this article to dwell upon the characteristics of the coil constant in the different designs of transformers. It is obvious that if a transformer winding possesses a great many wide oil ducts, when its individual coils are spaced well apart, the oil has a better chance to surround and to enter between the coils than if the primary and secondary windings were each a compact coil. In the first case, where there will be a free circulation of oil around almost all parts of the winding, more current can be carried by the single turns than in the latter case, which is more likely to cause inner overheating. In other words, the first-mentioned and decidedly better design for larger transformers will allow a higher coil constant (dissipated watts per square inch of its coil surface) for a given temperature rise above oil.

Plain cast-iron boxes are used for transformers up to about 10 kv.-a., Fig. 2. Machines above this rating generally require tanks that are higher than would be necessary to merely inclose the transformer. To gain on surface and to save at the same time on height the sides of these larger tanks, up to about 75 kv.-a., are cast corrugated, Fig. 3.

For larger sizes of transformers the cast-iron box becomes too heavy and cumbersome. A very convenient way of building a tank with a large surface is to construct its walls of corrugated-steel sheets. The corrugating operation is done on heavy mechanical presses, furnishing waves of from 2 to 6 in. in depth. The proper number of these sheets is welded together by the oxyacetylene flame or the arc-welding process (Fig. 4) and then formed to the desired shape (round, oval or rectangular), and finally a base and a top rim of cast iron are cast on. This last-mentioned operation gives a very satisfactory amalgamation between the sheet iron and the cast iron. In fact, the entire machine—tank, transformer, cover and oil—can be safely lifted from the top. Fig. 5 shows a transformer of this type complete.

The cooling efficiency of corrugated tanks depends upon the depth and the pitch of the corrugations. However, the heat dissipated is not proportional to the depth of the corrugation. For a given tank perimeter a 6-in. corrugation, although giving almost twice as much developed surface per corrugation as a 3-in., will not dissipate double the loss, but only about 40 per cent. more. In other words, there would be no great gain in producing tanks with corrugations deeper than 6 in., not considering the mechanical difficulties.

Corrugated tanks can be made for self-cooled transformers up to about 1500-kv.-a. three-phase 60-cycle units. It is usually not practical to build larger tanks of this kind, because the construction becomes somewhat unstable with heights exceeding 12 ft., even if the thickness of the steel sheets is increased. Larger and higher tanks can safely be made of ¼- or ⅜-in. boiler plate, with a suitable dished header as bottom. Seams and bottom may be riveted or welded. Oval and rectangular tanks of considerable height, 14 ft. and more, have a tendency to bulge out on their flat sides on account of the internal oil pressure. They ought to be reinforced at the proper height by Z-bars or channel irons, riveted horizontally on the tank. Of course such a tank alone would not have the necessary surface.

Some ten years ago an attempt was made to increase the possible surface of a corrugated tank by arranging the corrugations in a star-shaped plan—so to speak, to corrugate the corrugations. A tank of this kind is shown in Fig. 6. These tanks were called compound corrugated. It was rather difficult to shape the tanks before their base and rim were cast on, which made them somewhat expensive. At the same time the next-mentioned tubular tank was developed, which was less expensive and which superseded the compound corrugated type.

FIG. 4. WELDING CORRUGATED SHEETS FOR TRANSFORMER TANK

One way to obtain additional surface is to weld into a boiler-plate tank a number of tubes, which are arranged in a single, double or triple row, and which communicate with the inside of the tank as in Fig. 7. This is known as a tubular tank. As the transformer heats up, the oil rises on account of its diminished specific weight and enters the tubes (which are surrounded by

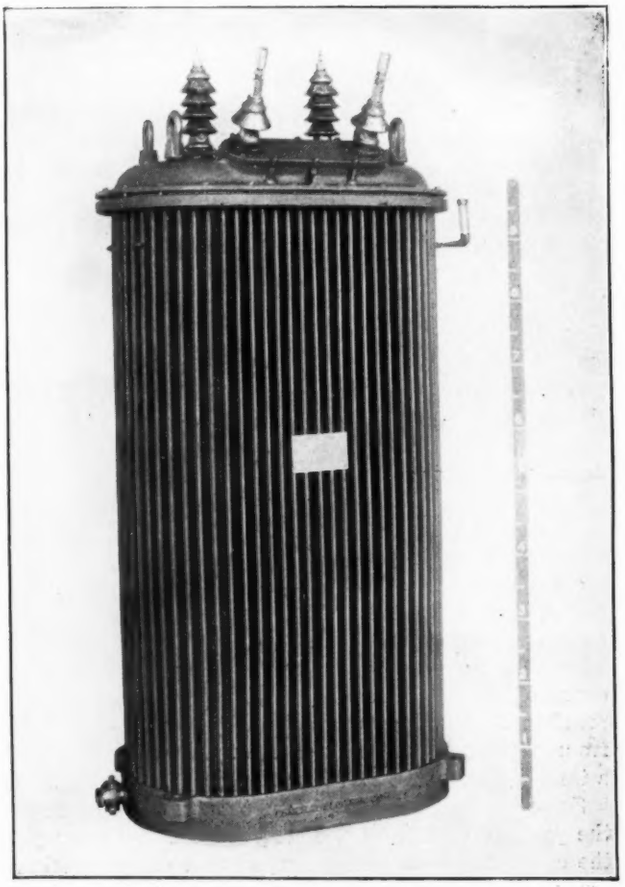


FIG. 5. CORRUGATED SHEET-STEEL TANK

freely circulating air), cools off, sinks within the tubes and enters at the bottom of the tank. In this way a so-called thermosiphon action takes place, which gives a very effective cooling. To give a tubular tank more than three rows of tubes is not efficient, because the inner rows would not get the benefit of being exposed to enough cold air. Thus again a limit of output is reached with the tubular tank at about 5000 kilovolt-amperes.

This amount of energy, 5000 kv.-a., was considered for a while as about the maximum output for a self-cooled transformer, simply because all attempts failed to gain economically more surface than a triple-row tubular tank. All transformers above this rating had to be built as artificially cooled units. Only recently a new kind of tank has been developed, which practically does away with any limit as to size of transformer. It is a combination of radiators with a tank, radiator tank. A special tubular radiator was designed which, when attached to either a corrugated or a boiler-plate tank, Figs. 8 and 9, gives a very effective transformer tank. A number of sheet-steel tubes are welded into a top and bottom header of pressed steel, and each header is equipped with a horizontal standard-pipe flange. Into the tank are welded corresponding vertical companion flanges, and cast-iron elbows making the top and bottom in communication with each other, plainly shown in Fig. 10. This construction possesses the following features:

1. Mechanically it is very rigid.
2. The radiators are extremely light in weight.
3. Radiators are detachable, enabling a large tank with disassembled radiators to be shipped, allowing the shipment to come within the limits of the width of a standard-gage railroad car.
4. All radiators for the same tank are identical and therefore perfectly interchangeable.
5. The construction is perfectly and permanently oil-tight.
6. The radiators are built in such a way as to exclude all pockets.

The possibility of changing the surface of such a radiator tank by varying one or four factors—namely, surface of main tank, number of attached radiators, number of tubes per radiator and length of individual radiators—gives the greatest flexibility and adaptability to any special requirement. Furthermore, this fact makes it possible to adapt the over-all dimensions of a certain unit to different operating conditions. That is to say, a transformer for outdoor service may be built rather tall, with a high tank and a few long radiators. The same unit, if installed in a power station, where height is limited, can be placed in a short tank with a great number of short radiators, and in both cases the total surface and the resulting cooling action will be the same. This accomplishment is possible with no other style of self-cooled tank.

Except for the required floor space there is no limitation as to the output of a transformer in a radiator tank, because it is not difficult to design such a tank with practically unlimited surface. Recently, a number of single-phase 25-cycle transformers rated 8000 kv.-a. each were built, one of which is shown in Fig. 10. These machines represent the largest self-cooled transformers ever built. Each of these radiator tanks had a total radiating surface of nearly a million square inches. This unit was described in *Power*, July 24.

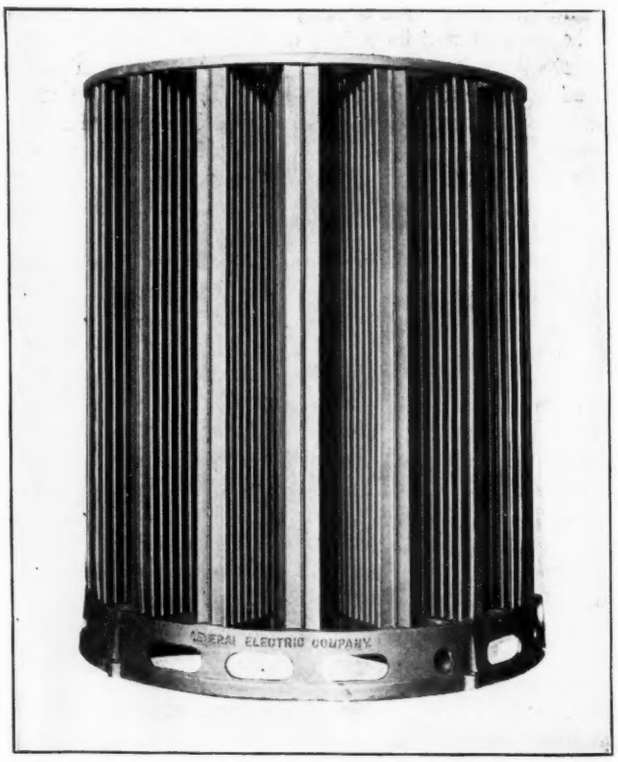


FIG. 6. COMPOUND CORRUGATED TRANSFORMER TANK

With the exception of air-blast transformers so far only self-cooled transformers have been considered; that is, machines that are cooled only by natural convection and radiation and which represent units entirely independent of any artificial means of cooling. It is plausible that when a self-cooled transformer is desired, a certain amount will have to be paid for the necessary radiating surface. It is always possible to build for the same output a less expensive transformer, with very little surface, just enough to inclose the machine, but there must be found some means to cool the oil by some artificial way, as for example with water. As both transformers will perform electrically the same service, it is in every case a matter of purely commercial and local investigation as to what type it is best to choose.

Under certain conditions, where the load taken from a transformer varies widely, it is now becoming the practice to use self-cooled-water-cooled transformers. This type generally consists of a corrugated tank with a cooling coil inside. The surface of the tank is such as to take care of the usual load. When the peak load comes on, water is circulated through the cooling coils, carrying away the additional heat. The valve operating the admission of the cooling water can be controlled from a contact-making ammeter.

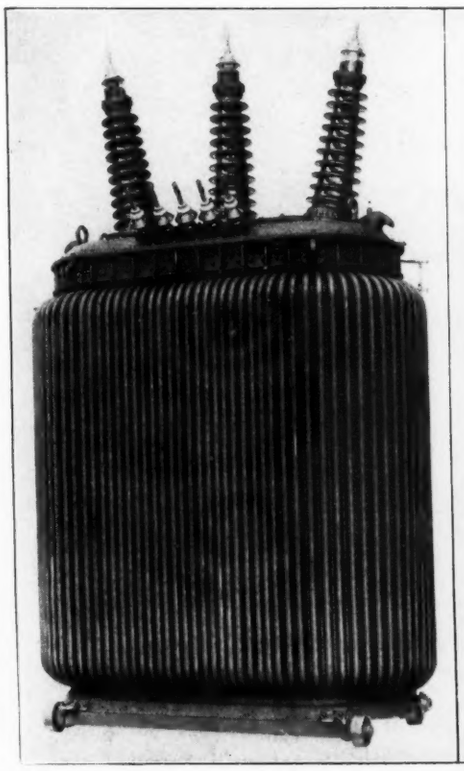


FIG. 7. TUBULAR-TYPE OF TRANSFORMER TANK

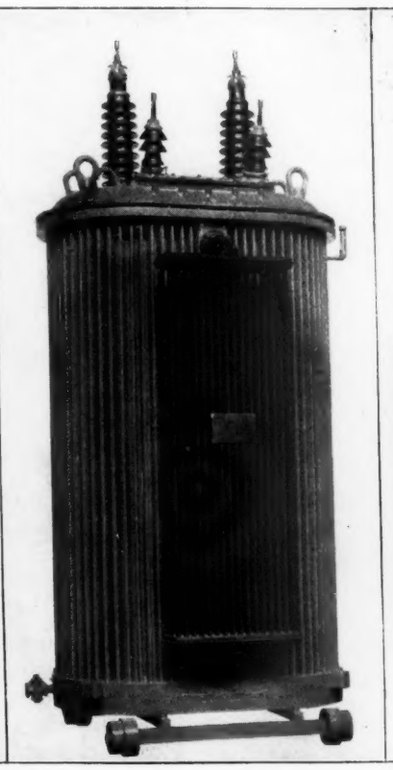


FIG. 8. CORRUGATED TANK WITH RADIATORS

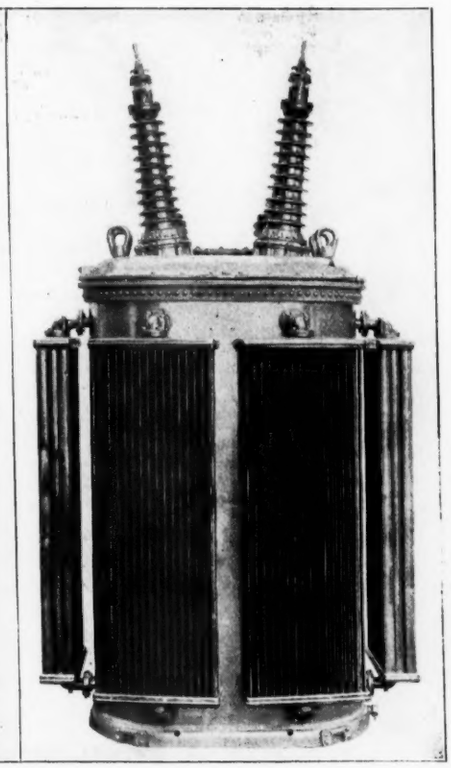


FIG. 9. BOILER-PLATE TANK WITH RADIATORS

The water-cooled transformer, Fig. 11, is the standard type of artificial cooling. Above the transformer proper and within the tank, which is mostly of boiler-plate construction, is placed a coil made of tubing water is forced through this coil, thus carrying away the heat from the oil. The coil can be made of wrought iron or copper. Brass is unreliable on account of its tendency to disintegrate under constant vibration caused by the frequency of the alternating current. If the length of the coil is considerable, the hydraulic resistance becomes too high, and it is then customary to divide the coil into two or more groups which are operated hydraulically in parallel. For outdoor service in northern climates this cooling coil should be made self-draining; that is, the inlet and the outlet should be made the lowest part of the coil, in order to prevent water from freezing within, in the case of a shutdown. In designing water-cooled transformers very little attention is paid to the radiation of the tank; practically all heat is taken away by the cooling coil. As it is possible to give the cooling coil any desired length, there is no limitation in output imposed on the water-cooled transformer. Units as high as 14,000 kv.-a. have been built and installed, one of which is shown in Fig. 12.

In cases where the normal load of such a transformer is more than, say, 1000 kv.-a. a radiator tank, either corrugated or boiler plate, may be used with an additional cooling coil inside to take care of heavy overloads.

A further combination is possible between a self-cooled transformer; which may be again either a plain corrugated, a corrugated tank with external radiators or a boiler-plate tank with radiators, and an air-blast transformer. That is, either of the above-mentioned tanks can be placed above an air pit, and a current of air, supplied by a blower, directed by properly arranged deflecting plates upward along the sides of the tank. A bank of several transformers can be cooled from one blower. During the normal load the tanks operate self-cooling; when the overload comes on, the blower is

started. This can be made to act automatically as in the first-mentioned self-cooled-water-cooled type. These combination transformers may be overloaded up to about 50 per cent. more than normal capacity without the temperature exceeding a safe value.

It frequently occurs that a customer has a self-cooled transformer which proves to be too small for his present requirements, and he wants to know how much more he could get from the machine if he would provide some additional cooling, such as inserting a cooling coil or placing the tank above an air pit. In such a case an overload of an appreciable duration, several hours or even continually, can be expected only if the oil is kept cooler than at normal load. The copper may then be operated at a higher current density. It should be remembered, as stated in the beginning of this article, that the copper losses increase proportionally to the square of the current. The limiting feature in such a proposition, therefore, is not the possibility of furnishing the necessary additional cooling surface, but the allowable current density.

TABULATION FOR THE MOST SUITABLE COOLING OF TRANSFORMERS OF ALL SIZES

Max. Output 60-Cycle Single-Phase	Cooling System
5	Natural-air-draft. Self-cooled oil in cast-iron tanks.
50	Self-cooled oil in cast-iron tanks.
1,000	Air-blast. Self-cooled oil in corrugated tanks.
3,000	Air-blast. Self-cooled oil in tubular tanks. Water-cooled oil.
10,000	Self-cooled oil in radiator tanks. Water-cooled oil.
All sizes above 10,000 kv.-a.	Self-cooled radiator tanks. Water-cooled oil.

Adding a water-cooling coil to a transformer designed originally as a purely self-cooled machine may give up to about 50 per cent. more output. Placing a self-cooled transformer above an air pit may give up to about 30 per cent. more.

Still in other cases, instead of placing the cooling coil in a transformer, it can be installed outside of the tank. The ends of the coil are in this case connected to the top and bottom of the tank, a circulating pump is inserted in the pipe line, which draws the hot oil from the upper part of the tank, forces it through the cooling coil and pumps it back in the tank. The coil may be erected, for example, on the roof of the power house, where a sprinkler system supplies a continual shower of water over the coil, or in hydro-electric plants the coil may be submerged in the forebay or the tailrace. As the oil is continually under pressure, this system, first developed

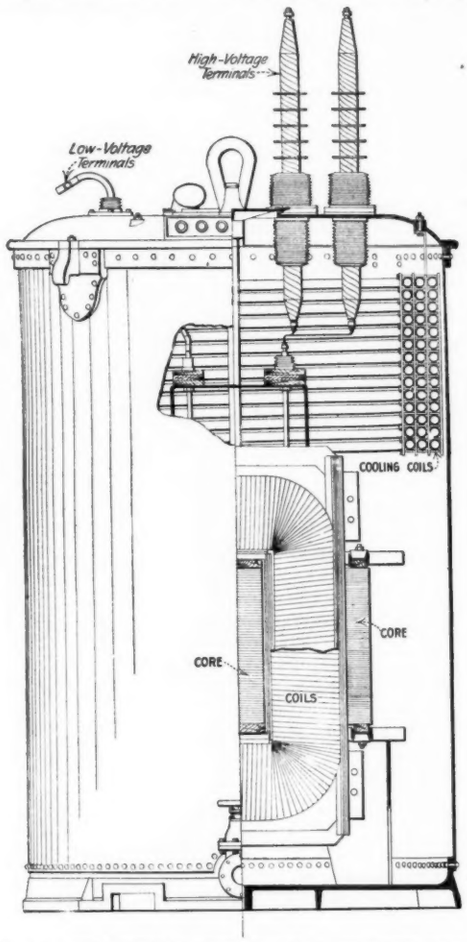


FIG. 11. SECTIONAL VIEW OF A WATER-COOLED TYPE TRANSFORMER

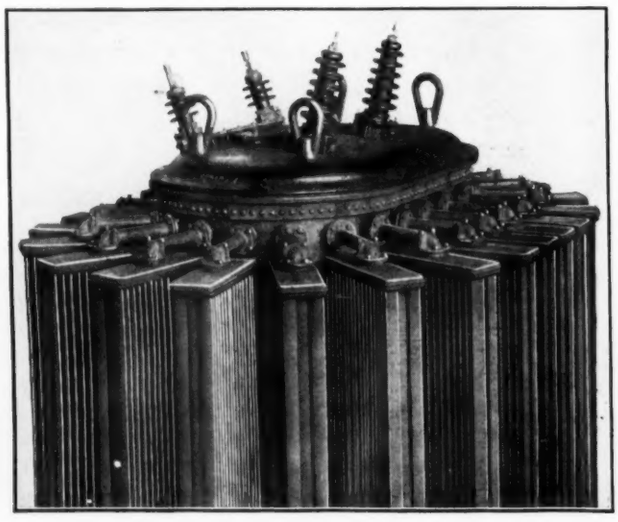


FIG. 10. RADIATOR-TYPE TANK FOR TRANSFORMER, 8000 KV.-A. SINGLE-PHASE

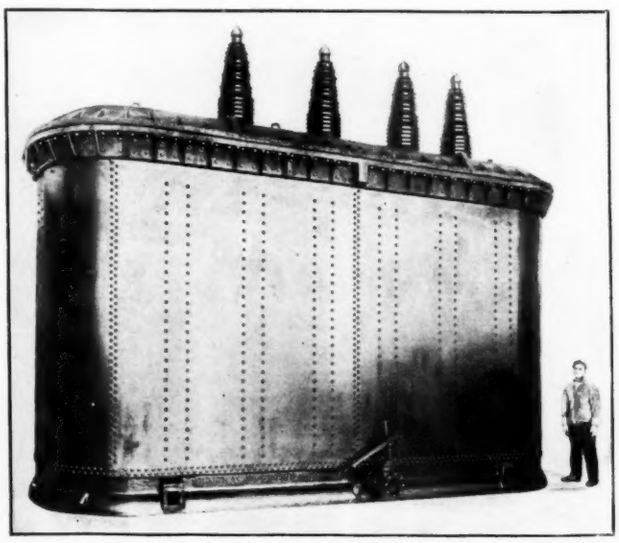


FIG. 12. WATER-COOLED, OIL-INSULATED TRANSFORMER, 14,000 KV.-A. CAPACITY

in Europe, has the great advantage that in the case of a leak in the cooling coils, the oil is always forced out into the water. In such a case water never can enter in the oil lines and the transformer.

For the sake of completeness a rather peculiar system of cooling will be mentioned. In the case of a transformer of very high secondary current, the low-voltage winding can be designed as a heavy copper tube, and cooling water forced through it. This gives an ideal cooling because the conductor itself is cooled from its own inside.

The chronological development of the different types of transformer tanks is as follows:

a. Natural-draft dry type.
b. Oil-immersed self-cooled in box tank.
c. Air-blast dry type.
d. Oil-immersed water-cooled in boiler-plate tank.
e. Oil-immersed self-cooled in plain corrugated tank.
f. Oil-immersed self-cooled in compound-corrugated tank.
g. Oil-immersed self-cooled in tubular tank.
h. Oil-immersed self-cooled in radiator tank.

On the opposite page a tabulation is given, which attempts to give the most suitable kind of cooling for transformers of all sizes. However, it is obvious that no fixed rules can be given even in a general way as to the most favorable type of transformer. In every case local conditions should be carefully considered in order to determine which system would be the most economical.

Care of Gas-Engine Bearings

By A. L. Brennan, Jr.

All mechanical appliances are subject to more or less depreciation, but in the majority of cases this depends on the amount of care and attention the machine receives. This holds especially true of the several bearing surfaces of internal-combustion engines. The chief means of reducing bearing wear to a minimum is proper lubrication. However, bearings are apt to overheat even when employing a thoroughly efficient lubricant. This may be caused by the bearing being set up too tight, or even by too much play, but in the majority of cases overheating can be attributed to improper lubrication, lack of good oil or other nonfrictional medium.

In the case of an overheated bearing which is being oiled with ordinary lubricating oil, it is a good plan to apply cylinder oil until the bearing is again operating at its normal temperature, as cylinder oil will be far less liable to burn and clog the oil ways and channels.

White-metal or babbitt bearings should only be cooled with oil in large quantities. It will be found that a little flour of sulphur added to some oil and applied to an overheated brass bearing will help materially in reducing the temperature, but this treatment must not be applied to either white-metal or babbitt bearings, as the sulphur has a marked tendency to act as an abrasive on these antifriction metals.

Sometimes a spray of very soapy water will reduce the temperature of an overheated bearing when other methods prove ineffective. By applying wet lumps of cotton waste and pouring water on the overheated bearing, high temperatures can be quickly reduced; but care must be exercised not to chill and thus crack any of the parts.

Bearings that overheat owing to being set up too tight should be removed and the binding points of the surfaces removed by scraping and not by slacking the holding nuts and bolts as is sometimes done. After the two halves of a bearing fit the shaft properly, if still too tight, suitable shims should be fitted to separate the halves of the bearing sufficiently for a correct fit with considerable tension on the holding bolts.

In view of the fact that the intermittent force that is applied to the piston is in the form of a shock, the prime importance of having the several bearings perfectly free from lost motion should be apparent, consequently, the bearing bolts should be set up firm. Owing to the high temperature of the cylinder, discretion must be used in making adjustments to the piston-pin bearing as it is liable to expand considerably when the engine is running. The bearing on the crank end of the connecting-rod should have no play in the direction of travel, but should be so that it can be moved slightly along the shaft with a bar.

When scraping in a bearing, especially the last-mentioned, care must be taken to get the bearing in contact over its entire surface, at right angles to the length of the connecting-rod. This is of the utmost importance, for if the bearing is the least out of line, undue stress will result.

Scraping in a bearing, although the work of an expert, can be undertaken by the average operator in case of emergency; however, care must be exercised not to cut away the corners of the bearings. This is quite a common mistake and is due to the fact that there is a tendency toward scraping away the easier parts to cut. After scraping off a thin cut, a little thick paint is applied to the shaft, the bearing bolted into position and the shaft revolved. When it is again taken down, the distribution of the paint will indicate how nearly correct the fit. But very little metal should be removed at a time, especially when an approximate fit is had. Worn bearings are often repaired by the removal of a shim or by filing their flat surfaces so that they will close a little more as the situation suggests.

In regard to lubricants, a thick oil is not necessarily a good lubricant, for its viscosity may be inferior. The fact should be remembered that, to prove most efficient in maintaining friction at a minimum, the adhesive and cohesive properties of an oil should bear the first consideration. An oil, to prove dependable, must have properties to withstand the pressure of the ordinary load under the conditions it is used. However, little trouble should be encountered if reasonable care and attention are given to the bearings and their lubrication.

Use extra-heavy pipe and fittings on the ammonia system. In making screwed ammonia joints do not use a pasty substance of any kind, as the particles get jammed between the threads and, while the joint may be tight, it will be only a short time when the ammonia will leak through at a time when one has plenty of other urgent matters on hand. The first requisite to tight joints is a good, clean thread on both pipe and fitting; then lubricate them with a mixture of lubricating oil and graphite.

War Emphasizes Need of Intelligence in the Boiler Room

By CHARLES H. BROMLEY

Rich in fuel, for years profligates in its use, consumers vainly hope to correct the evil overnight. We are the prodigal son stranded. Continued improvements in stoker and furnace design demand greater effort in producing higher intelligence to direct boiler-room operation.

THE most accurate estimate from available figures shows that 252,000,000 tons of coal per year is burned by less than 220,000 stationary firemen. These men consume over a billion dollars' worth per year, taking coal at $5 per ton. It is quite certain that not more than 5 per cent. of these men receive training that is the result of organized, intelligent effort. What few of these men are organized, exert only sporadic attempts to educate themselves to better do their work. No sensible man expects them to. The order of intelligence in the average boiler room grows lower rather than higher, while in exceptional plants a superintendent of a most commendable intelligence is employed.

It is a national mistake, an industrial crime, not to train boiler-room crews to keep pace with progress in stoker and furnace design.

Failure to do this seriously discourages stoker designers to add economy-effecting refinements to their apparatus. There is a horizon beyond which it is now futile to go. There is a limit to the investment that an owner or engineer will expose to loss due to incompetence. It is likely that limit has already been reached as far as standard design is concerned. As users of stokers and furnaces, engineers and owners must provide, on the whole, more intelligent operators or hold their tongues if designers manifest reluctance or openly refuse to improve standard design. Space does not warrant citing cases here to convince one of the truth of this; but all, or nearly all, stoker manufacturers as well as observing engineers, can tell you of many.

It is time to stop giving currency to the balderdash about the stoker making possible the use of mere laborers in the boiler room; it is true only when constant, intelligently trained superintendence of operation directs the labor.

I do not wish to discourage attempts to educate the firemen; but surely stable success in economical boiler-room operation lies in providing equipment of such design that the number of intelligent, trained men required to direct and maintain safe, economical and continuous operation is reduced to a minimum—to many thousands of installed boiler horsepower per man.

There is weeping and wailing and scurrying and bustling now to educate the fireman to save coal. We are prodigal sons stranded. We experience remorse after profligate years. And like the Bolsheviki we reach out for something that is farther beyond grasping than we

are willing to admit. We cannot achieve economy overnight when we have for years neglected it because "there's lots more (coal) where that came from and it's cheap."

The war convinces—it has not revealed—all but the most dumb that a new school of men must operate the boiler room. He is the fellow who has a trained mind and is not afraid of dirt and heat. He is the man who knows how to select the coal for the stoker and vice versa; who talks in terms of related weights and measures and knows when he is approaching or going beyond the highest over-all efficiency line. He is coming up through the ranks by reason of will and study, he comes also from M. I. T., from Carnegie "Tech.," from Wentworth, from Stevens and elsewhere. His name is Norman Reinecker, "Bill" Frear, Haylett O'Neill, Victor Azbe, and others I know and many I do not know.

Sometimes I feel that it is unfortunate that plant owners are being convinced of the need of high-class men in the boiler room at a time when a ruthless enemy makes paramount united effort by all. Otherwise I should feel that engineers who have long tried to convince them should let them chafe for a while under the cost before they seriously tried to bring them relief. That shows a human though a mean disposition. The owners and managers of power plants large enough to employ even a few men must realize that the intelligent boiler-room engineer or fireman will not stay where he must hang his clothes on a rusty rail alongside the coal pile, wash his face in a greasy bucket and dry it on the tail of his shirt. The employer must do his bit to induce men into this important part of the plant. And one of the best kinds of welfare work is to advise the studious, ambitious oiler and engineer who has come from the fireroom that a good job awaits him in the boiler room as soon as he proves fit for it.

There has never before been a time so favorable as the present to enlist the aid of the plant owner in getting universal economy in steam production. The better grades of fuel must be more economically utilized, and we must develop every channel leading to the most efficient use of the lower grades.

It is a welcome propaganda. War has given it impetus, and the commercial struggle after this cataclysm of blood and tears will make necessary its prosecution with undiminished vigor. America's wealth in coal is the fundamental reason for its woeful waste. The boss, the plant owner, needs as much education in this respect as the firemen. And engineers must teach both.

Wagon and Truck Loader

The man-power that has been and is being exerted through the country in shoveling coal from a pile on the ground into wagons for carting to boiler rooms is tremendous, to say nothing of the time and expense involved. In many instances it is not feasible to handle coal by means of a conveyor to the boiler room. In others it is not possible to deliver the coal even at a convenient point for wheeling, and in such cases the cost of the fuel is increased. With the present great demand for labor and the higher cost of fuel, labor-saving machines are essential in all kinds of power plants.

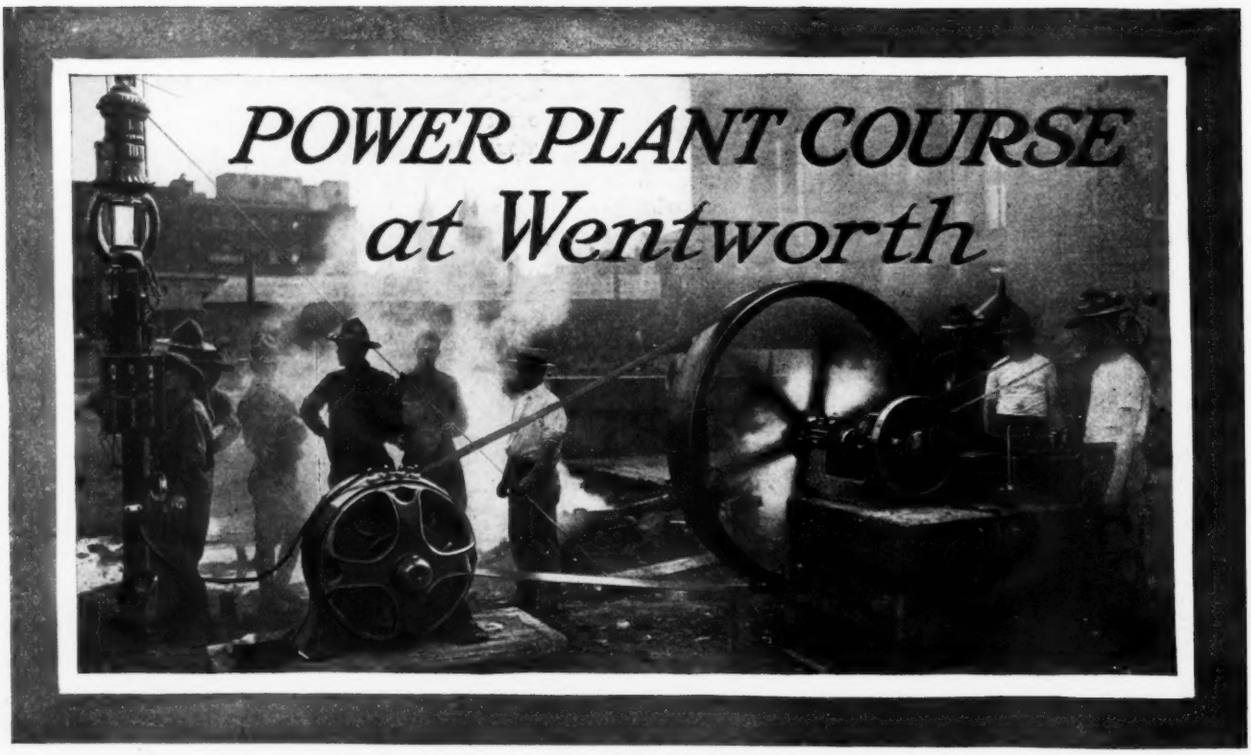
Being confronted with the necessity of loading coal from ground coal-storage piles by other means than hand shovels, the American Optical Co., of Southbridge, Mass., solved the problem by purchasing the wagon and truck loader shown in the illustration. This machine is capable of loading the material at the rate of one ton per minute and requires but one man for operating.

LOADING A MOTOR TRUCK WITH WAGON AND TRUCK LOADER

The situation in this case was that the coal-storage pile was some distance from the power house, compelling the transportation and transferring of the coal before it reached the boilers. The motor truck is kept on the "go" constantly, as it requires only a few minutes to load it. The coal arrives by the carload and is dumped from a trestle to the ground-storage pile. It is then loaded into trucks by the loader for transportation to the power house, where it is again transferred and sent to the boiler stokers.

The automatic loader is operated by an electric motor and fills the truck shown in the illustration in about five minutes. With its use the company has reduced the cost of handling the coal more than 50 per cent.

The utility of such a machine is easily seen in cases where it is necessary to shovel the fuel from the storage pile into wagons for carting to the boiler house, and the foregoing would indicate that the saving made would soon pay for the initial cost of the loader, which is manufactured by the Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill.



By CARROLL H. BEERS

WENTWORTH Institutes's new course in steam and electrical power-plant practice, a course which holds a unique position in the matter of equipment and instruction among like courses in the few schools in the country now devoted entirely to practical training in the mechanical arts, began this fall its second year with an enrollment of 116 students.

When the announcement was first made by Principal Arthur L. Williston last year that instruction in locomotive and engine operation would be given its pupils in addition to other subjects, Boston, the "Athens of America," pointed with pride to the course as an innovation in industrial education, for the departure marked the first attempt by any institution in the city to turn over an entire power plant for instructive purposes. The enrollment this year, the second of the course, is four times the number in last year's enrollment. Fig. 1 shows a view of the institute.

So far as the writer has been able to determine, Wentworth is the first school in the country to offer a full-time day course devoted entirely to power-plant

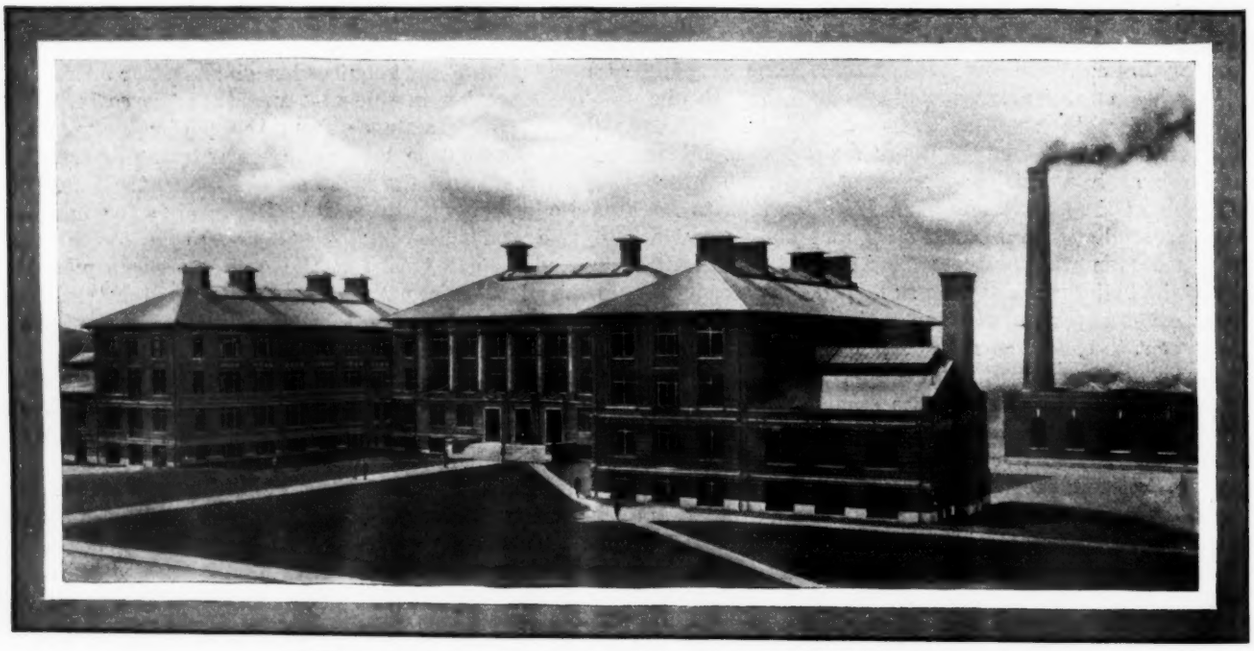


FIG. 1. WENTWORTH INSTITUTE, BOSTON, MASSACHUSETTS

engineering. Master mechanics, furnace and boiler experts, operating engineers of the highest type, station operators and power-plant superintendents are among the positions to which such a course will pave the way. Experienced engineers with first-class licenses will not be turned out. The instruction and opportunity for first-hand practice, however, is so arranged that young men who wish to hold responsible positions in the important and rapidly growing field of generation and distribution of steam and electrical power will become so thoroughly grounded in both the practical and theoretical sides of their work that they will be enabled to become first-class engineers in a comparatively short time after leaving school. Fig. 2 shows students firing.

Under the Massachusetts laws, from two to three years' employment is required to secure a first-class engineer's license after obtaining one as a fireman, provided the applicant passes his examinations as fast as he is allowed to take them. Statistics show that the average age of men receiving first-class engineer's licenses in this state is 35 years. In other words, from 12 to 15 years are actually spent by the majority of prospective engineers to attain what should be possible in from three to five if the man be equipped with the necessary theoretical and practical training at the start.

In addition to the stress laid on the importance of getting a firm grasp, from an intellectual standpoint, on everything connected with a power plant, it is inter-

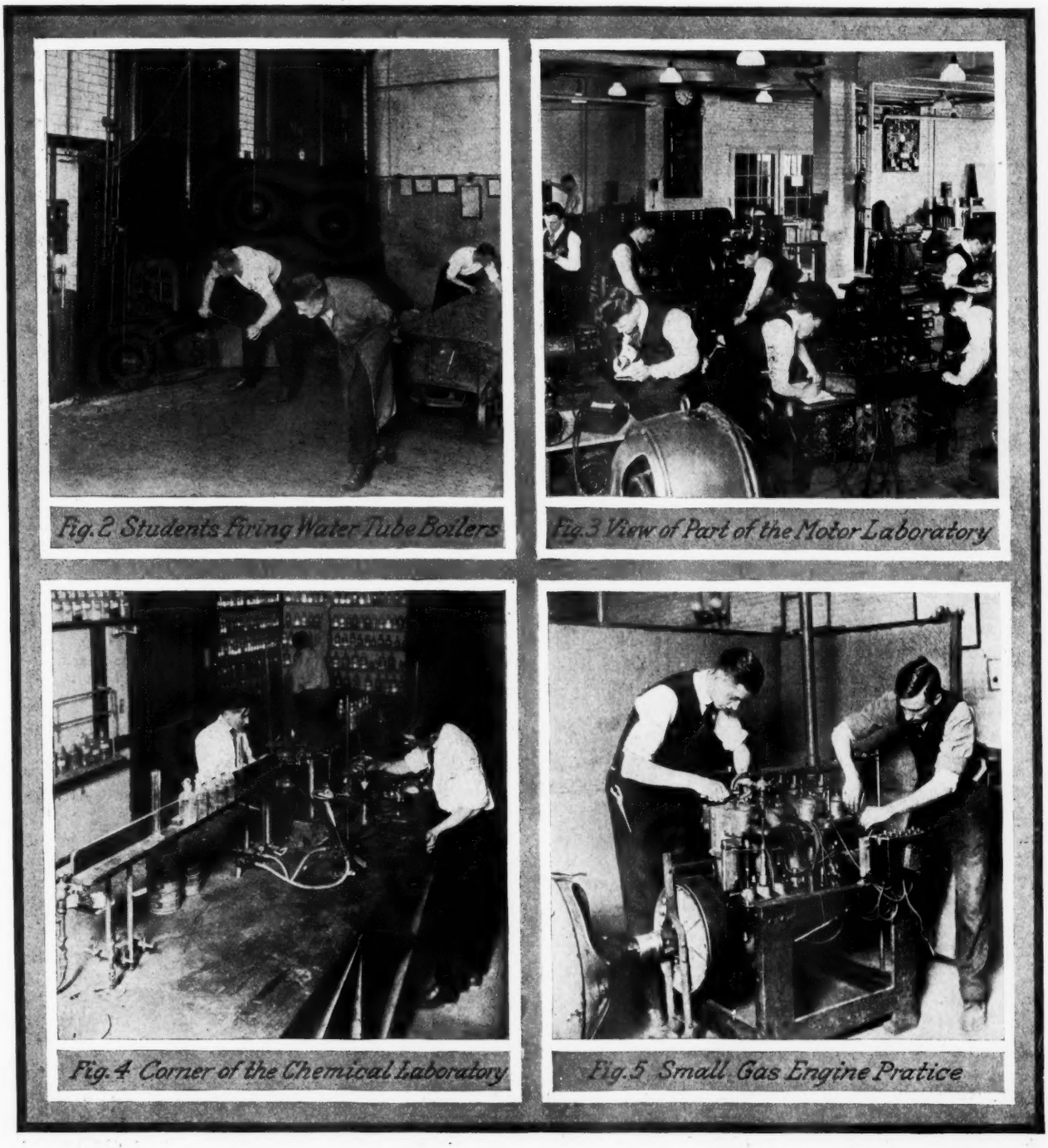


Fig. 2 Students Firing Water Tube Boilers

Fig. 3 View of Part of the Motor Laboratory

Fig. 4 Corner of the Chemical Laboratory

Fig. 5 Small Gas Engine Pratice

esting to note that Wentworth men also know what it is to use their hands. Anything savoring of the "arm-chair" spirit is overcome in such a rational and yet effective manner that the student invariably finds himself shoveling coal and otherwise plunged into the less skilled part of his new work almost without his realizing it. The aim from the very beginning has been to create in the student a passionate interest in his work—an enthusiasm in power-plant practice that will stay with him even during his hours away from the school. Fig. 3 is a view of part of the motor laboratory.

Steam and electrical power plants in recent years have made such rapid improvements and have increased in size and complexity to the extent that, more than ever before, men in charge of their operation and management must have a degree of special training and technical knowledge that formerly was not expected of men in similar positions.

Men of Special Training Needed Today

Today, owners of large and complicated plants are demanding men who, by their ability to control the various temperatures, pressures, volumes and weights occurring in power plants, are able to reduce the expense of operation to the minimum. To this end, 22 pieces of new equipment have been installed in the various laboratories, boiler and engine rooms. Among the apparatus are a 10 x 14-in. Houston, Stanwood & Gamble steam engine; a 10- and 10 x 10-in. Ingersoll-Rand air compressor; an Ingersoll air tank, 36 in. diameter, 8 ft. long; a 10 x 24-in. Brown engine; a 6- and 10 x 8-in. Blake air pump; a 6- and 4 x 6-in. Blake duplex boiler-feed pump; indicator testing apparatus; C. H. Wheeler condenser; Mason steam trap; Crane tilt traps (demonstration); 1-in. Foster pump governor; and a 2½-in. steam Koppe separator. Still others are a direct oil separator, an 8 and 5 x 10-in. McGowan pump; a National feed-water heater; Hyatt roller bearings complete; Ames engine 7½ x 10-in. with fittings; a 25-hp. Ames locomotive boiler and fittings, with a complete set of fire tools; Blake & Knowles outside packed plunger pump; B. F. Sturtevant turbine blower and governor; an International Engine Co.'s horizontal tubular demonstration boiler; Babcock & Wilcox boilers; pump governors; damper regulators; Cochrane open feed-heater and meter; Ridgway uniflow engine and generator; and a Blake vertical engine. Fig. 4 shows a corner of the chemical laboratory.

What Wentworth Institute accomplished toward training nearly fifteen hundred members of the 101st Regiment of U. S. Engineers for their arduous duties in France stands out as one of the greatest single achievements in the history of the school. For six months, as long as the troops remained in Boston after the declaration of war, they were afforded the exclusive use of the entire institution with all its equipment and facilities. Nearly the whole faculty, some 30 in number, worked in shifts during the long summer months to place the embryo engineers on a sound footing. The regiment was in many respects a picked organization of men of more than ordinary education who realized that upon their shoulders would probably rest the success or failure of the entire division. Fig. 5 shows students in small gas-engine practice.

From April until the latter part of September the spacious approach to the main entrance of the buildings as well as the surrounding yards, bore the appearance of a miniature cantonment. Army tents completely engulfed the central buildings. Armed sentries surrounded the institute grounds, making it necessary for a stranger to present a pass or special permit to gain admittance; in short, everything connected with the school was subordinated to the vital task of preparing the engineers of the 101st Regiment for service in Europe.

Under the direction of the Wentworth instructors, these young military-engineers-in-the-making constructed a line of concrete trenches of the latest type, equipped them with electric lights and ammunition rooms, made concrete bridges over imaginary shell-holes, built a network of model roads across the rear yard of the school, and later, having made rapid strides in their newly chosen work, even helped lay tracks along Huntington Ave., bordering the institute, for the Boston Elevated Railway Co. The headpiece to this article shows troops with trench-lighting outfit.

Meantime, the new power plant, with its gasoline engines, locomotives, as well as the machine shops, laboratories and classrooms, had been thrown open to the troops and were utilized to the fullest by practically every man in the organization.

When the troops broke camp at Wentworth Institute in September, Maj. Gen. Clarence R. Edwards, commander of the New England Twenty-Sixth Division, sent a communication to Mr. Williston in recognition of the war services he and members of his faculty had rendered from which the following is taken:

> It gives me pleasure to acknowledge, with much appreciation, the patriotic and public spirit of the institute which is fortunate enough to have you as president, in making the 101st Engineers into a practical engineering component of the Twenty-Sixth Division, United States Army.
>
> I believe these troops start with the making of as good an engineer regiment as will exist in the army.

Roach Underfeed Stoker

For many years the subject of firing boilers by mechanical means has been studied by engineers, with a view to perfecting some device that would accomplish this purpose efficiently, at a low cost of installation and a simplicity of construction insuring long life and a minimum of attention. As a result the use of automatic stokers has become nearly universal in all well-designed power plants.

The two requirements of every furnace without which it cannot completely fulfill the purpose for which it was designed are flexibility of air and fuel control. The control of the air consists in furnishing the proper amount to support combustion on all parts of the grates. Any excess air is merely lowering the temperature of the furnace, and is, therefore, wasteful, whereas an insufficient supply will not produce proper combustion. The control of the fuel consists in supplying the proper amount to the furnace, and its even distribution over the grates. The Roach underfeed stoker, Fig. 1, manufactured by Joseph H. Roach & Co., Inc., Philadelphia, Penn., has been designed to meet these requirements.

An examination of Fig. 2 shows how the control of the air supply is accomplished. The main air duct is shown with the damper by which the amount and pres-

sure of air is regulated. This duct extends the depth of the furnace and has a free opening to the retort zone, or the point of supply, which is also the coking zone where the volatile gases are distilled and where initial combustion takes place. Air at the greatest volume and pressure is required at this point.

Fig. 3 shows main blast gates which are provided in the sides of the main stoker frame. These valves are opened a sufficient amount to admit air to support combustion under the grates. As the grate zones require air for burning a coked fuel of slightly less thickness than over the retort, a reduction of volume and pressure is therefore necessary, and by these valves only the right proportion for proper combustion is admitted. It is not necessary to disturb these valves once adjustments have been made, excepting in case of a decided change of fuel. The air is admitted into the fuel bed

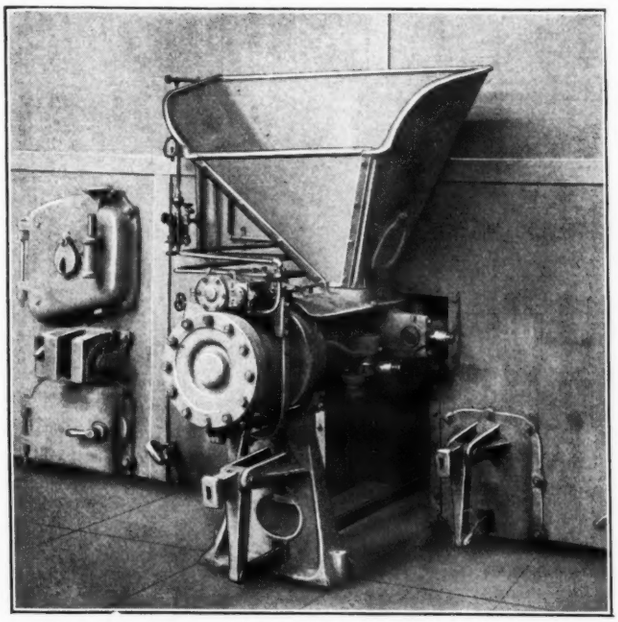


FIG. 1. ROACH UNDERFEED STOKER

horizontally, the grate bars being of open-bottom construction, thus giving free passages.

The mechanical means employed for feeding the fuel are of the underfeed principle. The coal is conveyed from the hopper by means of a steam-operated ram into a retort running directly into the center of the furnace and is underfed its length upon grate bars, some of which are stationary and some obtain reciprocating motion from levers under the stoker trunk. The arrangement of these levers is such that for every stroke of the ram the grate bars are reciprocated two strokes, and at the completion of each stroke of the ram the bars are brought with their inner ends flush with the inner face of the retort. This prevents the burning off of the upper edge of the retort side as might happen in the case of a low fire if this portion of the retort were unprotected. Another advantage of this double grate-bar motion is that by this means agitation of the grate surface is obtained, which is necessary to proper combustion and the prevention of clinkers.

As some fuels burn much freer than others, a control of their distribution over the grates has been provided for by means of rocker-arm rods on which are mounted removable spacers. The removal of one or more of these spacers results in a loss of motion in the rocker arm and consequently reduces the length of the grate-bar travel; this is accomplished without affecting in any way the length of stroke of the main ram.

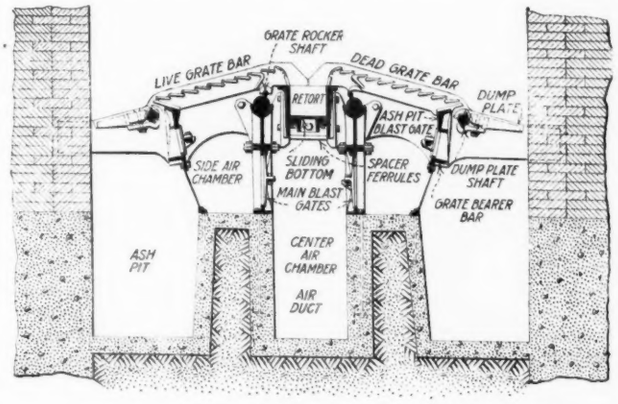


FIG. 2. FRONT CROSS-SECTION OF STOKER

The problem of ash removal without causing an inrush of cold air has been solved by ash trays that are along the side walls of the furnace, and when ashes have accumulated in sufficient quantity to make their removal desirable, a dog on dump gear on the front of the boiler is released, the trays are dropped and the ashes fall into the pit. The trays are then lifted back into position by a lever provided for the purpose. After the ash trays

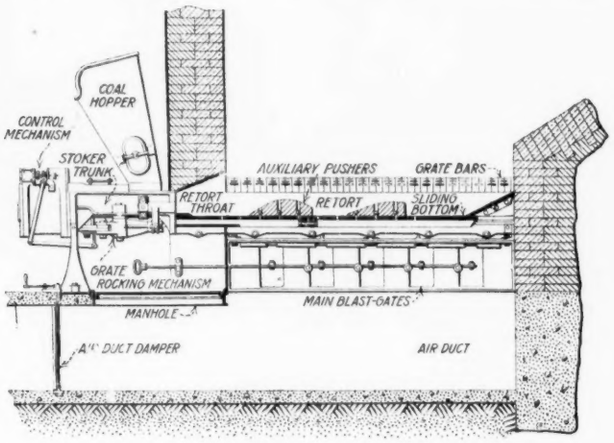


FIG. 3. LONGITUDINAL SECTION OF STOKER

are placed back in position, the ash-cleaning doors are opened and the ashes are removed without having cooled off the furnace.

In wire-rope technology the terms Regular Lay and Lang Lay are frequently encountered. Where the fibers of the hemp center and the strands of the cable are twisted in opposite directions, the rope is a Regular Lay construction; when the strands of wire and rope are twisted in the same direction, the term Lang Lay is applied. This latter provides a rope which is more readily untwisted, still it furnishes the operator with a product especially adapted to the resistance of external wear and grit action. There is also a construction known as a right-and-left-lay rope. In a rope of this type, half of the strands are made of the Regular Lay and half of the Lang Lay.

Tom Hunter, Hoisting Engineer

By WARREN O. ROGERS

We start for home, but before we turn in Hunter imparts a little information regarding hoisting ropes as related to stresses, their care and the spacing and arrangement of sheave wheels. Arriving at Chicago, we part to go our separate ways.

HAVING covered the most important copper mines, terminating with the power plant of the Calumet & Hecla stamp mill, we decide that, although there were doubtless other installations in which there were features of interest, it was time to return to our respective homes. Consequently, upon arriving at Calumet we engaged lowers for Chicago over the Copper Range R.R. The train left at 8:30 p.m., and as it was altogether too early to turn in, Hunter started to talk. There was no danger of disturbing anybody, because we were the only occupants of the car, the porter excepted. Outside the snow was falling in large, fluffy flakes, and as it had been snowing more or less for eight or ten days previously, I for one was satisfied to be starting back where the winter weather did not begin so early in the fall.

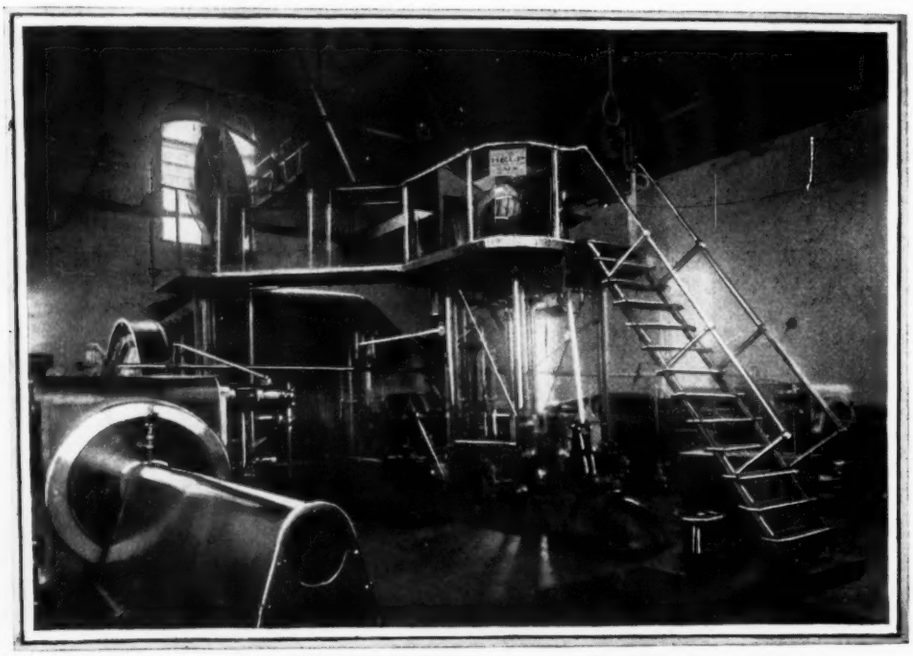


FIG 1. HOISTING ENGINE WITH LARGE CONE WINDING DRUM

"I'll tell you what," began Hunter, stretching himself into a comfortable position, "I have enjoyed myself this trip a good deal more than I expected to when I started out. Seeing things as we have broadens a fellow's vision as to what is being done by the other fellow. If it wasn't so late in the season and I did not have to get back on the job, it would require a good-sized rope to pull me away."

"Talking of ropes, it must require considerable attention to keep a hoisting cable in safe working order with the usage they get," I remarked.

"There are several points to keep in mind regarding them," replied Hunter. "Wear and corrision of the wires of which a cable is composed are difficult to detect as they are so frequently internal. The part of the rope most affected by the different kinds of deterioration will be found just above the point where it is attached to the skip, at the part that passes over the drum or sheave wheels when the load is at the bottom of the shaft and also such parts as come in contact with the flanges of the drum.

"You can readily see that the rope used with an inclined shaft will be worked with a less pull due to the gross load, according to the angle of the shaft, than it would be when used with a vertical shaft. But there will be a greater amount of wear and tear on the rope because it rubs on the shaft timber and rollers, and consequently the life of such a rope will be much less than in the case of a vertical lift. Because of this wear a larger cable will be used than is necessary to handle the load itself."

"How do you go about examining a rope for this internal deterioration?" I asked.

"When examining a rope, it should not be untwisted or opened. It is better to cut off a length of the rope when it is recapped, and an examination of the cut-off section will give a good idea as to whether internal corrosion has begun or not. At other portions the outside condition of the rope will enable one to judge as to its strength.

"You know that it is necessary to properly lubricate the frictional parts of machinery, and so it is also necessary to use a good rope dressing. In fact, it is one of the most important things to do in order to preserve the life of the rope. Don't think, however, that any kind of a slush will do. It won't, for a bad dressing may cause corrosion to a greater extent than if none at all were used."

"What kind of a dressing would you use?" I asked as the conductor shouted "all aboard" and the train began to move.

"I suppose about as good as any and probably better than most is a mixture of graphite and vaseline, linseed oil or other vegetable oils. What you want is a dressing that will stay soft and yet not run off the rope. With a wet shaft the cable should be lubricated at least once a week and sometimes oftener.

"I have always maintained that not enough attention has been given to the bending stresses of wire ropes, which is that produced in the small wires composing it when the rope is bent around a sheave wheel or drum. No matter what the diameter, the smaller the bend the greater the stress. You can't see this kind of a stress as you can ordinary stresses in ropes, and it is something that cannot be got rid of entirely, although it can be reduced to a minimum by using the proper size of sheaves and drums.

"Coupled with this bending stress is that of rapid winding, which is a large factor in the life of a rope. By rapid winding I don't mean the average hoisting speed, but the liability of shocks caused by sudden changes of velocity in starting to hoist. An unskillful or nervous operator could soon ruin a costly rope. It is to reduce these shocks that large drums are used." See Fig. 1.

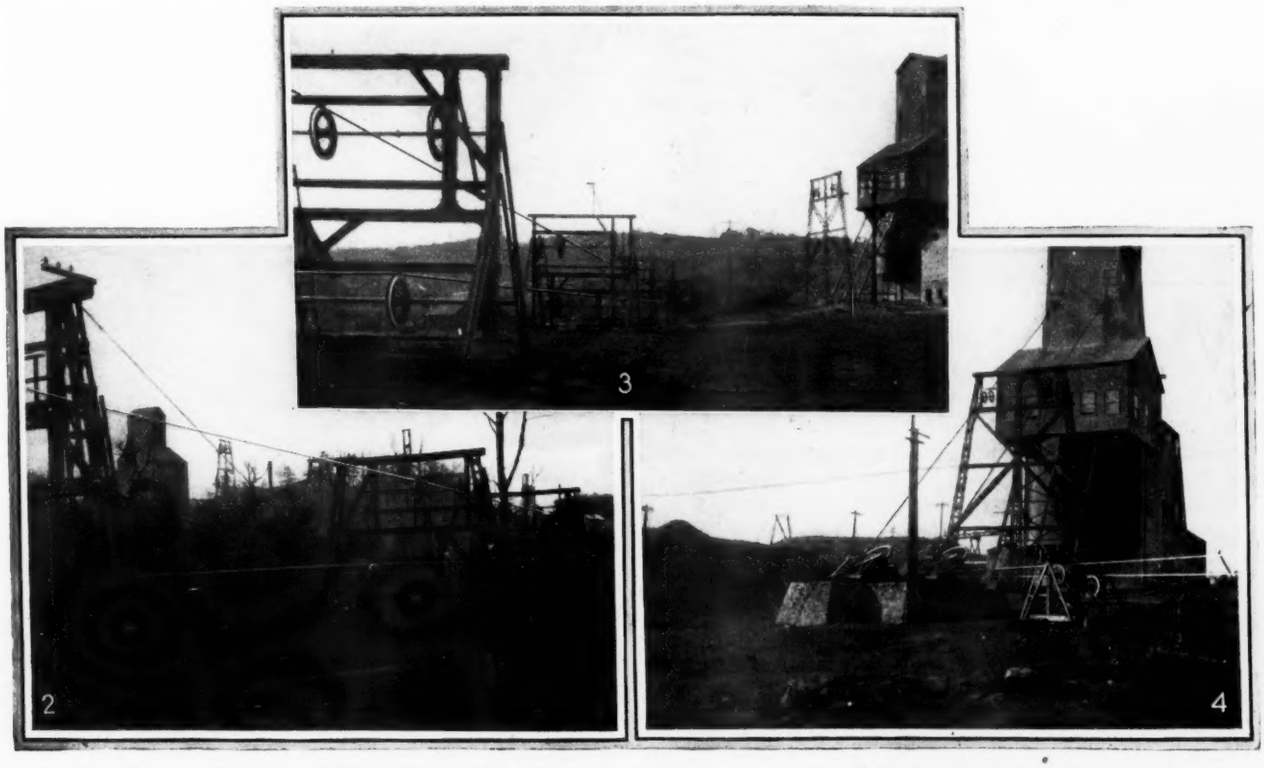
"All hoisting engineers, as you have doubtless noticed, start to hoist slowly and gradually increase the speed. It would not do to start with a jump, as that would exert undue stresses and if the acceleration were sufficiently high there would be the danger of snapping the rope. The shorter the rope the greater this danger, although it would not be impossible to break a long rope by a sudden jumping of the engine. A long rope is less likely to break owing to the amount of stretch at various applications of load, and the extension varies directly as the length of the rope.

"You have also observed that all the hoisting engines that we have seen at the copper mines are quite a distance from the shaft head and that the ropes run on sheave wheels spaced quite a distance apart. One advantage of this is that the angle of the rope as it leaves the drum to the first sheave is slight, not exceeding in good practice more than two degrees. If the angle is greater than this, the rope may rub against the rim of the drum when at the extreme end and cause considerable friction and wear.

"The figuring for wire ropes for mine use embraces a number of problems, one phase of which is the stresses in spans. Now the tension on a cable that is suspended between two points, such as between the supporting sheave wheels, of a hoisting system, of which you took several views" (see Figs. 2, 3 and 4), "is altogether different from that of any other part of the system. The distance between the supporting columns differs somewhat according to the availability of the proper foundations for the towers and the weight of the rope. As I have said, the hoisting engines are located at some distance from the shaft head and several sheave towers are used to support and guide the cables.

"The width of the winding drums requires that the engines be set back quite a distance from the shaft head when hoisting from great depths, so as to reduce the lateral, or side, deviation of the ropes; and as there is a severe backward pull on the head gear, the ropes are often run around sheave wheels near the surface and then horizontally to the winding drum." See Figs. 3 and 4. "This reduces the sway of the ropes during high winds and incidentally the cost of the construction.

"Some do not advocate that kind of construction because it may cause inconvenience to traffic about the surface by blocking the area between the head gear and the engine room. Most systems are supported by towers sufficiently high to provide ample room for passage below the cables." See Fig. 2.



FIGS. 2, 3 AND 4. VIEWS OF SHEAVE-WHEEL TOWERS SUPPORTING CABLES BETWEEN THE ENGINE HOUSE AND THE HEAD HOUSE

"Of course, it is important to have the sheaves towers aligned with the drum, and this is automatically obtained in so far as the sheave wheels are concerned by placing them on long shafts free to travel sidewise as the rope winds or unwinds on the drum. If the sheave-wheel tower is not set parallel with the center line through the drum, the rope will wear against one side or the other of the sheave wheels and will thus reduce the life of both the rope and the sheave wheel.

"There is another thing that should not be neglected, and that is the upkeep of the sheaves. If they become badly scored or worn, a new rope will not work properly, and it is good practice to turn out the sheave groove before putting on a new rope."

As Hunter talked, I found myself yawning, and seeing this, he suggested that we turn in for the night. The next noon found us in Chicago, where we parted company, each wondering where and under what circumstances we would meet again. I had enjoyed Hunter's company immensely and parted from him with regrets and with the firm belief that he would have to exert himself if at some future time he attempted to show me more powerful or interesting machinery than we had seen in the iron and copper country of upper Michigan.

Erecting Rotary Converters Without a Crane

BY NORMAN L. REA
Constructing Engineer, General Electric Co., Schenectady, N. Y.

Method of assembling rotary converters or other electrical machinery, when the field frame is divided into a top and bottom half, by the use of jacks, rollers and cribbing, is described.

MANY SUBSTATIONS are, unfortunately, not equipped with cranes and the standard roof construction is too light to carry much additional weight. Necessity is always the mother of invention, and the conditions named have developed a method of assembling rotary converters that may be of interest to *Power* readers.

A pair of jacks, rollers, crowbars and some cribbing are all the heavy equipment necessary. Ratchet screw jacks with a toe are recommended for this work. They are as handy as hydraulic jacks and are safer in the hands of rough labor. With the hydraulic type there is always the danger of lowering one jack faster than the other, and this may be disastrous. In any case the jacks should always be followed with substantial blocking so that the piece never has more than a few inches to fall should a jack fail or kick out.

The first step is placing the machine's base on the foundation, which has previously been cleaned and roughed, if necessary. The base should be leveled with iron wedges closely and evenly driven to prevent distortion. Bases must be considered simply as liners between the machine and the true foundation. The heaviest cast-iron bases can be seriously distorted by uneven spacing or driving of the wedges. In fact in several cases wedges driven under the outer edge only of the base have tipped in the bearing pedestals enough to take up all the end play. The base should therefore be grouted as soon as it is properly leveled and allowed to set thoroughly before the assembly is started.

A low dam of clay or bricks set in lean mortar should be placed around the base inside and out and grout, made of half cement and half clean sharp sand, thoroughly puddled under the base. It is inadvisable to run the grout up inside the base more than half an inch as the machine may have to be moved some day. A base that has been poured full of grout must actually be quarried out of a foundation, turned over and the grout dug out with a point and hammer. If you are in doubt about the sand, drop a double handful in a pail of clear water. If you can see the bottom in ten minutes, the sand is all right.

Remove the dam and any unnecessary grout as soon as the mixture has taken a set. The edge can be neatly pointed if this is undertaken before the grout is permanently set. The iron wedges should not be disturbed until after the machine is assembled. Three days to a week should elapse between the grouting and starting the assembly, this depending, of course, on the setting qualities of the cement used.

The assembly should proceed as follows: The lower half of the field is carried across the base on rollers

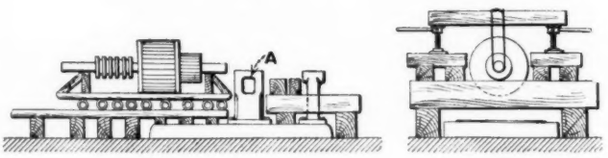


FIG. 1 FIG. 2

FIGS. 1 AND 2. DIFFERENT OPERATIONS IN ERECTING A ROTARY CONVERTER

until it is directly over its final location. The boxing and skids are then removed and the field lowered with jacks to its final location. Most rotaries have a pocket, as at *A* Fig. 1, in the outside of the lower field frame for the bolts holding the two halves together, and these pockets can be used to good advantage in lowering the bottom half onto the base.

The next step is to remove the collector-ring-end bearing pedestal and the cap and top half of the commutator-end bearing and skid the armature in over the collector-ring end of the base, commutator end first, until the ends of the skids come to the field frame. Fig. 1 shows the situation at this stage of the assembly.

Arrange the rollers closely under the skids and cut off the commutator ends of the latter enough to allow the commutator end of the shaft to be caught on blocking placed between the field frame and the commutator end pedestal. Another section of the skids is then removed and the armature moved forward until the shaft enters the commutator-end bearing.

During this movement the shaft may be carried on a wooden roller or on clean, greased blocking. A metal roll must not be used, and the blocking and grease must be free from dirt or anything that might score the shaft.

If the commutator end of the shaft has an extension and an oil deflector inside the bearing lining, the blocking must be high enough to carry over the bearing pedestal or the pedestal must be removed altogether. Most small converters do not have this extension, and the shaft can be moved the rest of the way in the bottom half of the lining.

In any case the blocking should be assembled so that sections can be readily removed to clear the commutator as the armature moves forward, and must be braced to prevent it tipping over.

The remaining section of the skid is removed during the last stage and the weight transferred to blocking under the collector-ring end of the shaft, or to a pad between the field-pole faces and the armature punchings. This pad can be made of heavy cardboard, sheet fiber, or old belting. Of course the blocking must be kept clear of the commutator, collector rings and windings outside the punchings.

The collector end pedestal may now be put into place, the armature raised by a jack under the shaft extension, the pad between the armature punchings and the pole faces removed and the lower half of the bearing lining placed in position. In some cases the scheme shown in Fig. 2 may be used to good advantage in raising one end of the shaft for work on the bearings. The shaft should, of course, be thoroughly cleaned, any burrs removed and well oiled before it is placed in the bearings.

When the armature is properly in place, the top half of the field is brought alongside the machine, in line with the lower half, jacked up high enough to clear the armature and skidded across the machine until it is directly over the bottom half. The skids are then removed, and the piece is lowered with the jacks to its final position. Of course this scheme requires considerable blocking to start with, but this rapidly accumulates from the boxing as the assembly progresses.

An experienced man will place the armature with only two cuts in the long skids. A beginner, however, had better play safe and may have to make three or four cuts as the armature is fed into the field. The assembly of the fittings, adjustments and starting is, of course, standard from this point, and is usually fully covered by the manufacturer's instruction books.

Improper Refilling of Fuses

One of the most serious abuses that has to be contended with in the electrical industry is the improper fusing of circuits. These abuses are set forth in Bulletin No. 74 of the Bureau of Standards, Washington, D. C., in the report on its investigation of cartridge-inclosed fuses, which states that the investigation has established several important facts.

The first is that there is in many places a certain amount of abuse of approved fuses. This may take a great variety of forms, many of which make it absolutely impossible for the fuse to perform its proper function, thereby introducing a serious fire or accident hazard either by lack of protection for circuits and apparatus or by danger from the operation of the fuse itself. The chief form of abuse of approved fuses appears to be the practice of bridging the fuse on the outside with heavy fuse wire, copper, or iron wire, or putting a nail or wire through the center of the fuse cartridge. Occasional forms of abuse met with consist of taking out the filler and pouring the fuse cartridge full of melted solder or placing a bolt through the cartridge. Some of these are extremely difficult to detect on superficial examination.

In Fig. 1 is shown a plug-type case for a cartridge fuse limited to 60-amp. capacity, and from all external appearances it is anything but a menace to life and property. Fig. 2, however, tells a different story. On removing the cap from this fuse case, the inspector found that the fuse cartridge had been removed and the bottom half of the case poured full of solder. What

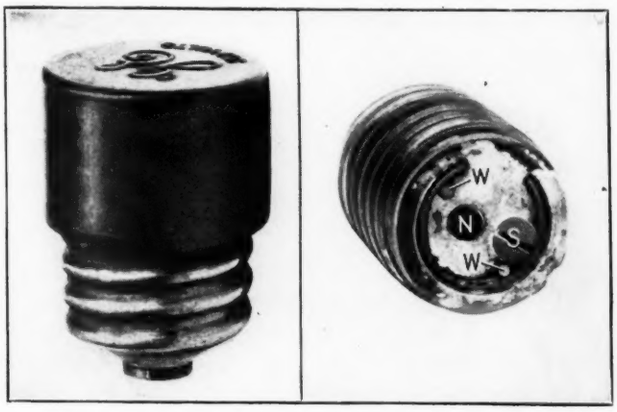


FIG. 1. PLUG-TYPE CARTRIDGE FUSE

FIG. 2. HOW FUSE CASE FIG. 1 WAS FILLED

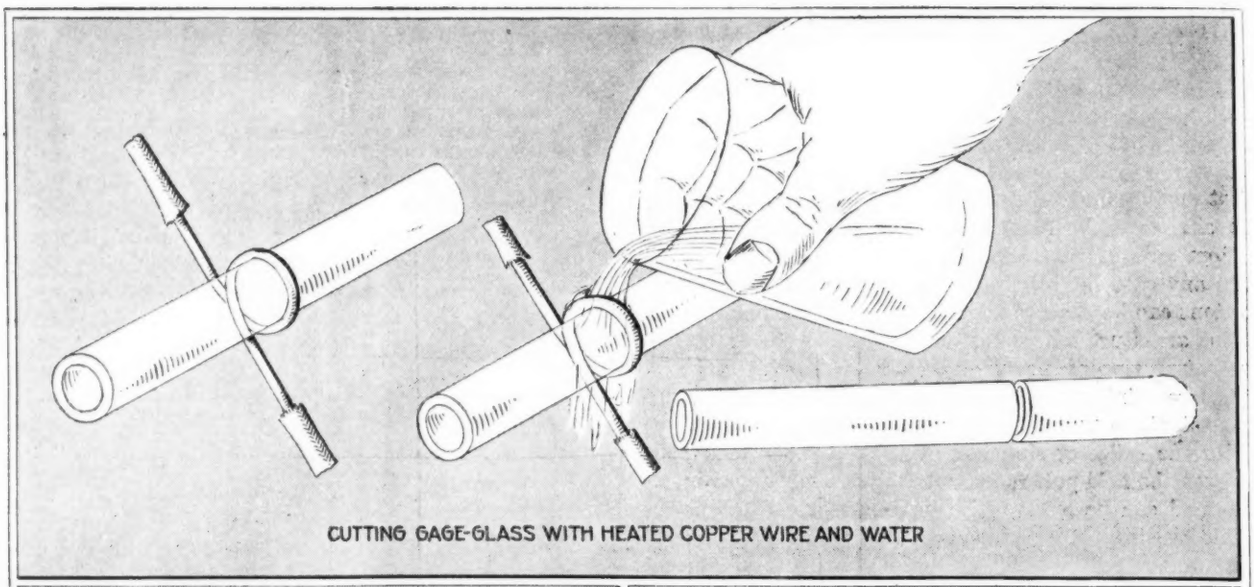
the purpose of the nail *N*, screw *S* and the two pieces of No. 12 wire *W* was, could not be determined. It may be that the one who did the job was a comedian and thought he was doing something funny. But the fact remains that a fuse doctored up as shown affords just about as much protection to an electrical circuit as a tied-down safety valve on a boiler in a power plant. From all appearances this job was intended for a permanent one, since to allow the cap of the case to be screwed down no farther than its normal position thick cardboard washers had been neatly fitted into the top of the cap.

In certain localities the tendency to abuse approved inclosed-cartridge fuses as above indicated is surprisingly great. On an inspection trip made by one of the engineers of the Bureau of Standards one out of seven of all (379) the approved enclosed fuses examined was found to be improperly filled.

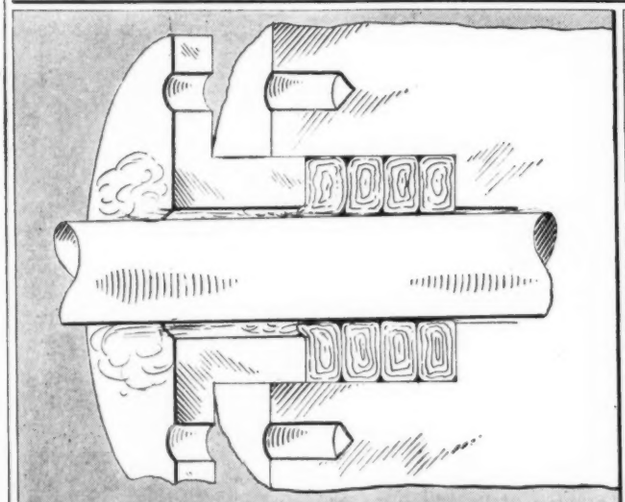
Such practices make it apparent that the licensing of electricians is a necessity, and those in charge of electrical equipment should be held responsible, under the penalty of losing their licenses and positions, for the safe condition of that equipment, just as the steam engineer is held responsible for the power-plant equipment in his charge in many of the states today.

One correspondent in *The Engineer* (London) suggests coining the term "pinch" for pounds per square inch; another objects, since the word already exists in both orthodox and unorthodox use, but in turn suggests "squinch."

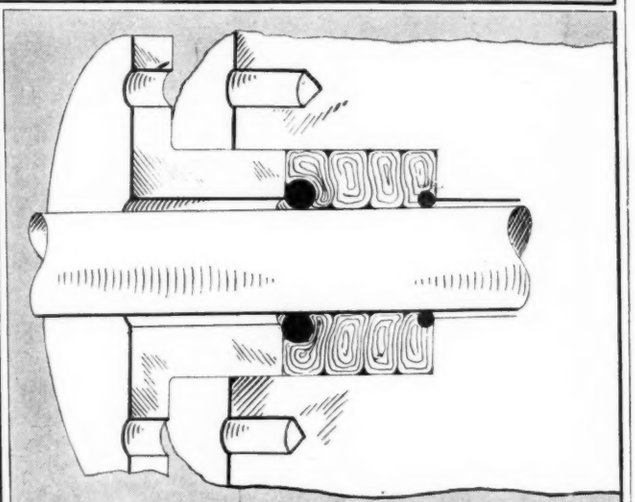
Engine-Room Kinks



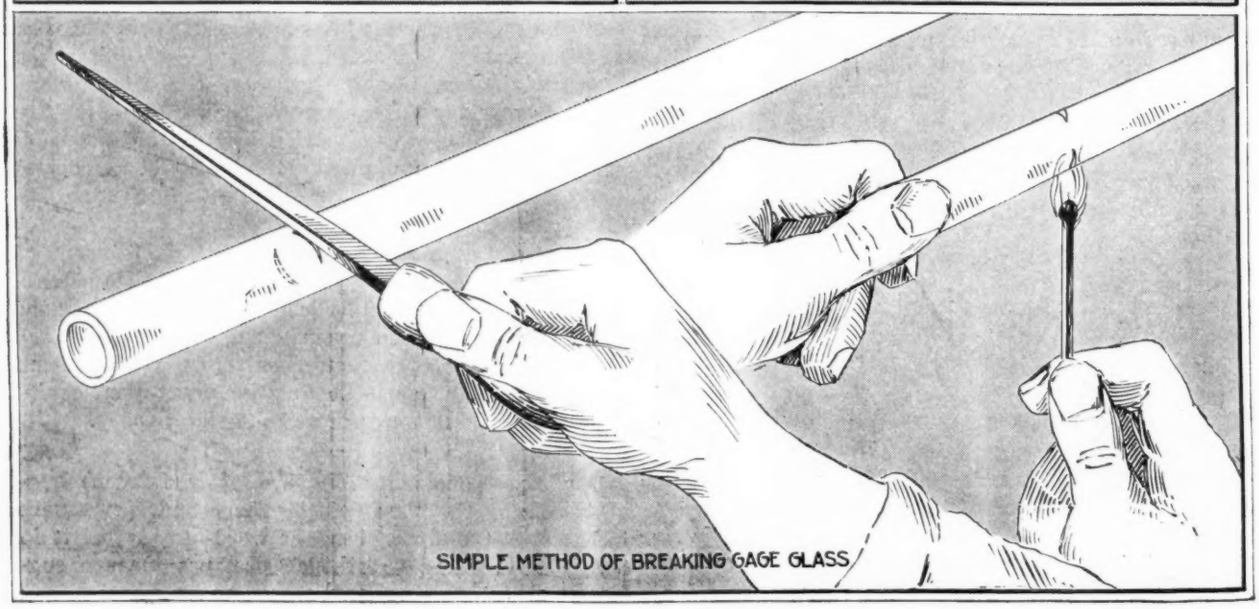
CUTTING GAGE-GLASS WITH HEATED COPPER WIRE AND WATER



WORN PISTON ROD, LEAKING PACKING



SPLIT COPPER RINGS THE REMEDY



SIMPLE METHOD OF BREAKING GAGE GLASS

Editorials

Knitting

So much was closing in about the women who sat knitting, knitting, that they their very selves were closing in around a structure yet unbuilt where they were to sit knitting, knitting, counting dropping heads.

—*A Tale of Two Cities.*

ALL over this broad land and others too, in homes and trains, at the theater and opera, in stores and shops and offices whenever busy hands find respite from other toil, women sit knitting, knitting in tender thoughtfulness for the comfort of the boys at the front.

And when the dwindling skein has taken its place in the sock, or helmet or sweater, they go and pay over four dollars a pound for more.

Before the war they could have bought it for less than two.

There are those who, anxious to devote their time and labor to the work, cannot afford to contribute the material; and so the Red Cross furnishes the necessary yarn at a reduced price, or even free, to those who will knit from it supplies for the soldiers; and business men write checks, and working men put in their dollars, and widows contribute their mites, and school children their pennies to swell the Red Cross Fund that the good work may go on.

Beautiful and touching devotion on the part of the women, knitting, knitting, that some brave boys may feel a little less rigorously the hardships of the trenches; noble and generous the sacrifices of the thousands who contribute to the expense.

But what of Mr. Yarnman? What of the difference between a dollar and a half and four dollars and a quarter a pound?

There is no element in the cost of that yarn that is not reducible to human labor; and human labor is not collecting the difference between the price before the war and now.

Do women enjoy knitting up yarn? Do people enjoy contributing to a fund to purchase it at extortionate prices that some may thrive upon the world's affliction?

Knitting is conducive to thinking, and the women who sit knitting, knitting, and the men who sit watching them are thinking, thinking as they have never thought before, over many things.

There is much that must be done besides knitting to win the war, and there are many things besides yarn that are essential to the fighters at the front and the workers at home. What physical reasons are there for the increase in the price of everything, and who is getting it? Decreased supply and multiplied demand is no answer. The old doctrine of "I have it; how badly do you want it?" will not stand the stress which is closing in. "The law of supply and demand," as President Wilson says in his late message, "has been replaced by the law of unrestrained selfishness." It ought to cost less per unit to produce and distribute greater quantities than small. It is no answer that labor is demanding higher wages. Except for some opportunists who would take advantage of the present shortage in man-power as profiteers are taking advantage of shortages in other lines, labor would be content to work through the war for the old prices if employers and handlers would be content with the old profits so that the purchasing power of their day's work would not be impaired.

This is a time for universal sacrifice, not of unnecessary sacrifice by the many to enrich the few. In the single year 1916, while people who could hardly make both ends meet before were paying outrageous prices for food and fuel, there was an increase in the number of millionaires in the United States of 7925. In every hour of that year we made a millionaire, and in order to do it thousands spent their last penny for the bare necessities of life, and many went ill-fed, scantily clad and insufficiently warmed.

The man who is holding that skein of yarn is beginning to wonder about the man who got that extra two dollars a pound. People are beginning to realize, when they read of companies bankrupt or nonexistent before the war that are now paying extra dividends or of clever manipulators who have turned over hundreds of thousands in a few months, that they are the ones who are paying the dividends and contributing to the unearned fortunes in the prices that they are paying for the necessities of life, and to demand that men who have grown rich at the expense of war-burdened peoples shall no longer be permitted to walk high-headed in respectable society.

The people are long-suffering and slow to anger, torn by conflicting habits of thought and lack of unity in the accomplishment of even a common purpose. Mass is their proper name, for they are full of inertia. But the inertia which restrains a great mass from impulsive movement under a suddenly impressed force sustains it in its crushing onslaught when, under unified impulses, it gathers momentum. A pendulum swings beyond the position of rectitude, and the higher it has been forced the farther it will go to the other extreme.

No man can hear unmoved his wife sobbing with hunger and his children crying with the cold. Not only the Saint Antoines but the Heights and Suburbs of American cities are commencing to rumble with the remonstrances of resentful consumers, and knitting women and thinking men are commencing to inquire after Names. Food Riots, Shortage of Grain, Taxes on Incomes, Corn Laws, Bread Lines, Hoarding, Short Weighting, Regrating of Food, Overcharging, Committees of Subsistence, Restriction of Trade—you will find them all in the story of the events which led up to the French Revolution, and No Sugar is the title of one of the chapters of Carlyle's History.

Given willing, interested, enthusiastic man-power, and there will be enough for all; enough to win the war, enough to avoid painful deprivation in its winning. We have land, we have forests, we have coal and minerals. The cost of sunshine and of rain has not gone up, nor

has the supply diminished. Human labor, and nothing else, can convert them into or win from them human sustenance and comfort—food and clothing and ammunition for our army, ships and rolling stock for their conveyance and distribution. The working men of America will work long hours, will redouble their energy to increase the output of our limited equipment, will submit to the dilution of their labor and to the temporary breaking down of the safeguards which they believe they have built about it if they can be assured that all are making equal sacrifices and that the deprivations which they undergo are imposed by the war which they are working to put down and not by profit-seeking manipulators who are making the world's necessity the minister of their unholy greed.

The only legitimate reason that labor has to strike at such a time as this is that extortion has made its share of its own products inadequate for its sustenance. There are conditions under which the returns of labor are reduced. If a farmer gets only half a crop, his product costs twice as much per unit, and there are doubtless phases of the present condition to which this consideration applies. But it takes no more labor to get a ton of coal out of the mine now than it did two years ago. If labor would do it at the same price, it ought to cost the other laborer who buys it no more, notwithstanding the increased demand; and if the clothier who buys it and all the workers who contribute to his product will be content with their old profit and wages, the miner's original wage will buy as many clothes as it did before; and so of all the other necessities.

Let us stand behind the Government in its effort to organize the supply and distribution of essentials and to fix their prices. Let the activities of labor be directed against the sulky remonstrators who are employing the best brains that money can buy in resentful opposition to any interference with their profitable game. Their best argument in justification of their high price is the scarcity and exorbitant demands of labor. Cut it out from under them by making labor efficient and continuous. Make the cost of production as low as possible and then insist that the product be sold at that cost plus a fair profit. So shall we avert stringency and famine, insure the continuous and efficient production of the things we need, avoid the disorganizing effect of internal dissension and win the war with the minimum of avoidable suffering.

War Coal

IN LAST week's issue, under the title of "War's Influence on the Coal Situation," appeared an analysis of the reasons for coal shortage at the points of consumption and of the rail-transportation situation as related chiefly to the movement of coal. The article contained figures to show that, contrary to the belief of many, there is no shortage of coal at the mines in the sense that the output for the year is not as great as last year. The coal output in tons is considerably more than that of last year, being 8.4 per cent. for the last eleven months, to be exact. Despite increased production, there is a severe shortage of coal at the points of consumption, owing to the greater activities of the industries, which, it is estimated, will increase the consumption by about one hundred million tons. But the gap between consumption and production figures is greater than appears on the surface. In the article referred to it was brought out in a table footnote (page 829) that the coal now being shipped contains a far higher percentage of refuse than the coal used during normal times. So much more, in fact, that the consumption per unit of output has increased for the average plant, it is fair to say, twenty per cent. To paraphrase an oft-used saying, "All is not coal that is black." The shortage, then, is worse than it appears to be by the excess ash the coal contains.

The following communication, just received from the Bureau of Mines, points out in an impressive way, what this increased refuse in the coal means to the operation of the boiler room:

> There is one phase of the present coal situation which may put an entirely different light on the supposed increased production of coal for the present year. In round numbers, there was produced 600,000,000 tons of coal last year. Statement has been made that 50,000,000 tons more will be mined this year. The preparation of this increased quantity of coal has not been as good as in times past. Analyses of samples show in many cases a greatly increased quantity of ash. Repeated cases are brought to the attention of the Bureau of Mines where coal which would run from six to eight per cent. ash in normal times is running from twelve to eighteen per cent. at present. Complaint about the preparation of coal is very general, and it is not at all improbable that five per cent. more ash is included in this year's coal than in previous years. If such a figure is true, it means that 32,500,000 tons of the estimated output of 650,000,000 tons is nothing but increased ash. If we can imagine over 60,000 carloads of ash being added to the present burden of transportation, the evident effect on the car supply and transportation troubles will be realized. If this were the end of the matter, it would not be so bad, but there is another factor well known to engineers, which is likely to be overlooked by the nontechnical user. The experiments carried on by the Government at the St. Louis Exposition showed that with coal used there was a decrease of about one and one-half per cent. in efficiency for each one per cent. addition to the ash content of the coal. That is to say, the inclusion of more ash with the coal not only decreases the value of the fuel by the amount equal to the excess ash, but it makes the good coal less effective to the extent of one and one-half per cent. for each one per cent. of ash. The inclusion of five per cent. more ash in the fuel, therefore, means a reduction in efficiency of the remaining good coal of about seven and one-half per cent., which, added to the five per cent. of useless ash, makes a total reduction in effectiveness of twelve and one-half per cent.
>
> According to this point of view, although 650,000,000 tons may be produced in 1917, its effectiveness as compared with the production for previous years is probably only about seven-eighths of this and equivalent to a production of normally prepared coal of about 570,000,000 tons. We have, then, instead of an increased production as compared with last year, an actual decrease of effective coal amounting to about 30,000,000 tons. If this is added to the estimated increased need, due to our accelerated activities, of 100,000,000 tons, we have a deficiency of the equivalent of 130,000,000 tons, instead of 50,000,000 tons, to make up by good engineering and true fuel conservation in the boiler rooms.

The problem of conservation in the boiler room is doubly difficult because results must be immediate, that is, by changes in operating methods and improved equipment in new installations and in extensions to present plants. One thing some operating engineers must get clear of, and that is, their reluctance or refusal to advise calling in a consulting engineer of repute to assist in the selection of equipment and the improvement of operating methods.

The engineer must be made to feel deeply that the country faces the gravest crisis in its history and that not since Joffre turned back the Teuton horde on the Marne, have the allied armies been so seriously threatened. We do not wish to seem pessimistic, but it may

prove to be the fact that before very long England and America only will have the strength to crush the Prussian menace. To make the available coal in the bunkers go as far as the best engineering can make it go under the local conditions is to contribute toward this achievement.

War Emphasizes Need of Intelligence in the Boiler Room

ELSEWHERE in this issue is an article that voices the sentiments of engineers who have been closely associated with the problems of increased efficiency in the boiler room. From current discussion of the subject of fuel conservation, it seems evident that many technical and nontechnical persons expect more to be accomplished by present boiler-room employees than the judgment of those who have for years been in the closest possible touch with these employees believe to be possible.

By the use of every available channel, the employer of boiler-room labor must be made to know that progress of the art of steam generation and of the combustion of fuel in boiler furnaces has advanced beyond the stage where, in view of the serious economic conditions that face the country, intelligence of a low order may be used to supervise operations. The labor situation in the boiler room grows worse rather than better. The growing use of fuel oil in New England is in truth due chiefly to considerations of labor trouble rather than to increased economy that may be effected by the oil.

The Fuel Administrator of Massachusetts, at least, has a number of men who are now visiting plants, assisting the boiler-room force to more economically burn the fuel and to suggest improvements in operating methods and to point out the need of immediate repairs.

There is no good reason why the local associations of the National Association of Stationary Engineers cannot assist the fuel administrators throughout the country by arranging with their employers, through the local fuel administrator, to get around to as many plants as absence from his regular place of employment will permit.

Limitations of Automatic Machinery

THE development of labor-saving machinery within the past quarter-century has been so great in this country that operating men are sometimes prone to ask themselves whether the time may not come when they will be of no use in the plant, or at least of so little use that it will not pay them to continue along present lines of work.

Attendantless substations have come into service, and in the industrial field wonderful achievements have been attained in automatic appliances. In the power plant hand labor is being superseded in many instances by machinery, and recording apparatus seems to take away all the incentive for instrument reading on the part of switchboard attendants and steam men alike. Yet there is no likelihood that such plants will become automatic enough to maintain their service at maximum efficiency automatically, so that skilled supervision becomes all the more important as the value of equipment installed increases. It is a great gain to the engineer to be able to devote himself to analytical service and to get away as much as he can from purely routine and humdrum duties. Whether it will pay to install a given automatic equipment is a question not always easily settled; but every engineer should give consideration to every appliance designed to enable him to perform his work more easily and give better control, while at the same time giving him time to do original thinking.

A Most Appropriate Holiday Gift

YOU can hit upon no finer expression of your good will to your responsible men than to make them a gift of a year's subscription to the paper that is published to help them to improved and economical results in their work.

Most holiday gifts are outworn and forgotten in a few months; but here is one that lives and grows with each week—one that will be a constant reminder to your men of your interest in them.

We have prepared an appropriate card announcing your gift. This will be mailed to each recipient, his subscription being entered as paid up to January 1, 1919.

War is no respecter of persons. Uncle Sam himself is not exempt from its inconveniences. This, in a word, accounts for the slow and irregular deliveries of their papers, concerning which some of our readers have written us. Upon making a careful investigation into the causes for these complaints, we find that these irregularities are traceable to the unprecedented congestion of the mails—due in part to the war program of curtailing train schedules, but mostly to the going into military service of many thousands of postal clerks. The post-office authorities assure us that no stone will be left unturned to get back to normal service at as early a date as possible. Meanwhile, until the necessary readjustments in service are made and new clerks are trained to take the places of the enlisted men, will you not be a little patient? We are helping Uncle Sam all we can to deliver your papers on time.

"In dealing with facts there can be no fear, and the fearless man is the only one who can achieve lasting results. Get the facts." So reads a paragraph in the isolated-plant section of the booklet advertising the commercial engineering course conducted by the National Electric Light Association. The point is, Mr. Isolated Plant Engineer, make the facts such that they are your weapons and you will not succumb to those you have handed the other fellow.

The asbestos output of the United States has decreased fifteen per cent. though the demand is greater than ever before. Thus the markets get the engineer coming and going. It costs more to produce heat and more to keep it after you get it. Well, we always did believe that statement of General Sherman's.

Those who make worth-while contributions to the world usually have a welcome sign over the door.

Correspondence

Fires Caused by Defective Electrical Installations

With regard to the promulgation of the electrical-installation rules as laid down by the National Electrical Code since its inception in 1897, the standards adopted by the framers have, with the necessary changes due to the advance of the electrical art, become mandatory in practically every opportunity and especially so with the larger and more important electrical interests and towns and cities. There is, however, a class of individuals who are either ignorant of these rules or disregard them and the interests of the safety-first movement. I refer to the writers of the so-called popular or home publications. For example, Miss Addie Farrar, in the September number of *The Modern Priscilla* advises her readers how to become their own electricians, as follows:

> If you want to remove an electric fixture, turn off the switch near the meter, the one that controls the current throughout the entire house, or you may have an accident. When this is thrown, you may work without danger. Unscrew the fixture and find the wires heavily bound with tape and rubber and unwind and separate these two wires. Then rebind the wire separately, using bicycle tape, taking care that the naked wires do not come in contact at any point. You may now either paper over the old fixture, place or put in a new fixture or attach a socket for a table or standing lamp. If you have many standing lamps in the house, it is well to get a double socket and set and have long wires running from them to the part of the room you wish to light. I sometimes run my wires along the baseboard and sometimes along the picture molding, and in this way I can run them clear around the room and they do not show until they drop to where the light is placed.

This authoress states that her advice will save "dollars on household repairs" because the mechanics and electricians charge for "knowing how." Verily this is so, otherwise imagine an electrician with a conscience running lighting wires along picture molding. Miss Farrar is not alone in imparting such hair-raising advice; her contemporaries are legion.

It is a regrettable fact that after the average new electrical installation in the home has been completed in accordance with the best standard practice, inspected, approved by the proper authorities and turned over to the householder's tender mercies, further hazards present themselves by virtue of changes and additions by him in following such directions as given above.

W. J. Canada, of the Bureau of Standards, at the September convention of the International Association of Municipal Electricians, stated that our annual electrical fire loss amounts to seven or eight millions of dollars, that only a fraction of this enormous loss can be attributed to the wiring installation proper, the major loss being attributed to old poorly maintained wiring and especially portable appliances. At this writing the National Fire Protection Association has, in coöperation with the Bureau of Standards, started an educational campaign covering homes, schools, etc., relative to electrical hazards of the household.

The average householder knows no electrical safety rules, no violations of municipal or underwriters' requirements, nor that usually his tinkering voids his fire-insurance policies. Let us hope, for the common good, that when he buys "unapproved" electrical fittings at the five- and ten-cent stores, he finds that there are more phases to the problem of "knowing how" and in "saving dollars for repairs" than are at first apparent.

MATHEW KING.

New York City.

Engineers, Professional or Otherwise

A number of letters have appeared recently pertaining to union and non-union engineers, in which the term "professional," as sometimes applied to operating engineers, is scoffed at and derided in a way that sets one thinking. It seems to me that there is much confusion of ideas in relation to this matter, which possibly may account for this difference of opinion. Having been in the engineering business from my youth up. a matter of thirty years, and still "working at it," my opinion as to the use of the term "profession" in engineering is as follows:

Engineering as a whole embraces the professional as well as so-called practical engineer; it is necessary that there be both, and one class is just as essential as the other. There is, or should be, a close relationship between the two. But in the eternal fitness of things the actual practical workers should not be classed as professional, and as a general rule they do not want to be so classed. I do not mean to say that there is an impassable barrier between the professional and the nonprofessional class, for there is not. For example, an army corps of engineers consists of a number of men of all the mechanical trades and the different subdivisions of those trades. The officers of such a corps are trained engineers as well as trained military men, and they plan, devise and supervise the operations of the corps while the rank and file do the actual mechanical work under foremen who are the noncommissioned officers. A private is not styled a professional engineer, nor would he want it so, while the officers would rightly expect to be called professional engineers; the same thing relatively applies to engineering matters in civil life.

Steam engineering as a whole is a profession, but all who are employed in it may not be professional. A great many requirements have to be fulfilled before one may call himself a professional engineer. Comparatively few "get there." But what is the difference if we have gone as far as our ability can take us and if we are doing our full duty in whatever station of life we happen to be? So, why have any minunderstanding? If an ambitious engineer reads, studies, belongs to an educational association, and strives to "learn more" so that he will be ready to "earn more"

when his opportunity comes (and come it will), he should not be subjected to ridicule as though he were posing as a professional engineer. It is true that unions of all kinds enable their members to get better pay, and that certainly is commendable, but the man who desires to become a "noncom," or even a commissioned officer, so to speak, must accomplish for himself what the union cannot do for him. Individual effort is the essential thing in progress, not the clinging dependence to any organization, union or otherwise.

Scranton, Penn. CHARLES J. MASON.

Automatic Stoker Operation

For the benefit of the men who will have to operate automatic stokers sooner or later, I wish to point out a few things that they will rub up against.

In operating with forced draft, be sure that there is not an excess air pressure in the furnace, which is indicated by flame or smoke belching out around the doors or through leaks in the furnace walls. If the air cannot flow to the chimney without interruption, it will accumulate in the furnace and flow out wherever there is an opening. If this occurs when the breeching dampers are open, it may be caused by an accumulation of soot. Soot will bank up on the lower baffle of horizontal-baffled boilers, as I have found in a number of cases.

In the same type of boiler and setting with the same furnace trouble, I found that the bridge-wall had been built 8 in. nearer the lower baffle than it was originally

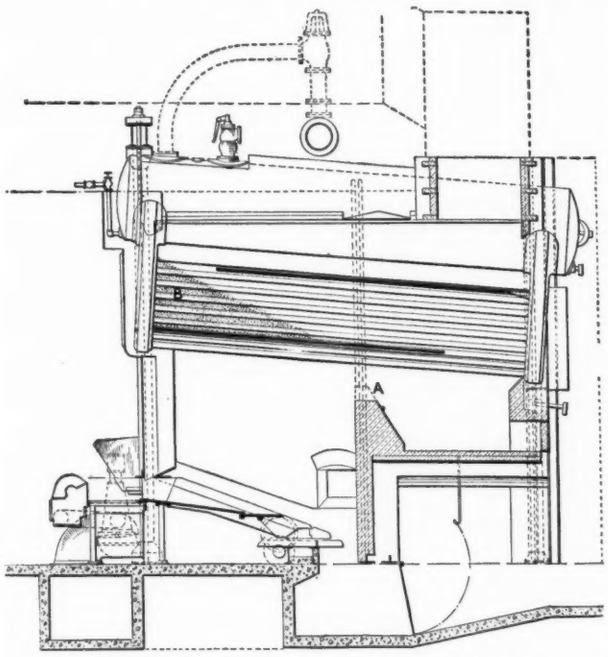


FIG. 1. HIGH BRIDGE-WALL AND SOOT ACCUMULATION ON LOWER BAFFLE

designed. It gave no trouble after two rows of 2½-in. thick firebrick were removed from the top at *A*, Fig. 1. The illustration also shows where the soot *B* was found and where the bridge-wall was too high.

In another case soot trouble was overcome by changing the soot blower from the back of the boiler to the front. When blowing the tubes, all drafts were shut off and the soot was forced back so as to fall into the combustion chamber, as it was too heavy to blow up over the next baffle and out to the chimney.

At the same plant I had another experience: We were running with good coal, low in ash and with but little motion on the grates. During the day a dirty

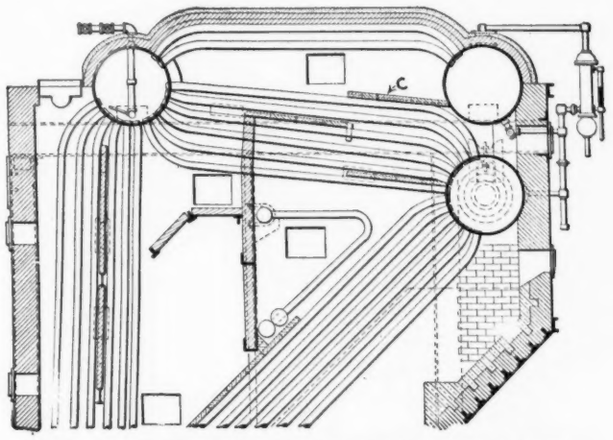


FIG. 2. EXTRA BAFFLE RETARDED THE DRAFT

grade of coal was delivered, which ran 23 per cent. ash, 3 per cent. sulphur and contained but 11,000 B.t.u. This coal formed a clinker because no one was expecting it to do so. This clinker formed from wall to wall and extended to the bridge-wall. It required more than two hours of hard work to clean one fire, which would have been needless had we known what to expect, because the long stroke on the grates would have sent the ashes down to the ash pan before they had a chance to fuse together. A front-plunger-fed sloping stoker was used. This goes to show that to be a successful operator one must be always on the watch to catch the little things and remedy them before they grow into large troubles.

I was nearly "stumped" at another place with furnace draft. The trouble was found to be from an extra baffle that had been put in so close to another that it held the gases back and prevented the boiler from operating at rated capacity. By removing a few baffle tile, that trouble was overcome and the boilers could be easily run continuously at 180 per cent. of rating. Fig. 2 shows the type of boiler and where the extra baffle was located, as at *C*.

As soon as excess pressure is built up in the furnace, the limit of what can be obtained from the boiler is reached. With a free passage of gases through the setting and a clean shell without and within, the harder the fires are forced the greater the capacity that can be secured from the boiler, and the greater the economy that will be obtained, provided the furnace is not forced hard enough to get too high a breeching temperature.

The ideal furnace condition with front-feed plunger stokers is a level fire 10 to 18 in. thick, depending on what air pressure is under the grates, or a fire of such thickness that if kept level will be burned to ash by the time it reaches the bridge-wall.

I have heard operators say, "That may be all right in some cases, but not with the load I am carrying." It can be done and is being done in plants where boilers are working at normal rating and in others where the range is as high as 350 per cent. of rating. If it can be done in these plants, why not in all?

In almost every instance where coke goes out in the ashes, it is because the operator does not carry the fire level and have it burned down to ash by the time it gets to the end of the grates. Sometimes it is caused by dumping the ash pan when the fire is very heavy, as then the fire will roll off the ends of the grates.

Some types of plunger stoker have a safety pin for each plunger, which protects the vital parts from breakage. If a pin breaks put in another, but if that one breaks stop right there and look for the trouble, which may be a clinker attached to the brickwork, or a stone, a piece of iron or wood in front of the plunger.

I know of one man who put in pins until he used 18 lb. in one day on one plunger. Yet when asked what the trouble was, he said, "Nothing, only the pins wouldn't hold." Looking up the trouble, it was found that a block of wood was in front of the plunger and if the pins had held the stoker itself would have been broken.

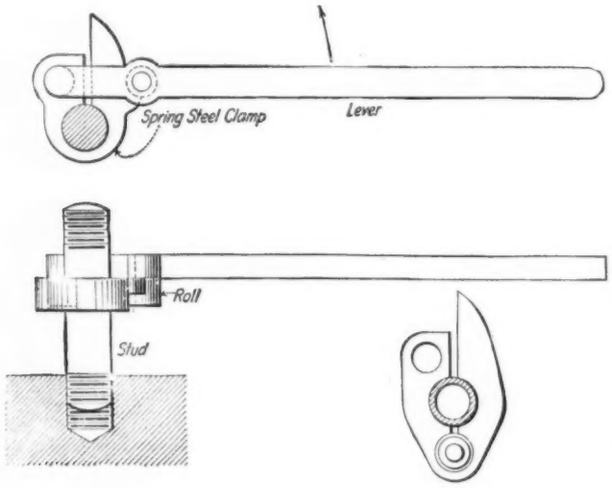
Another precaution—never let a fire burn in the ash-pit, but put it out with water or rake it out of the pit before the castings of the stoker warp or burn; also to save the brickwork or concrete foundations.

Any engineer who studies the coal he is using and experiments in burning it in different ways will soon see what is needed and be ready for trouble, regardless of the quality of the coal. There is only one way to be successful and that is by always watching for trouble and remembering that any stoker is only a machine and depends on the human element to do its work properly.

Cleveland, Ohio. W. R. CATON.

Stud or Pipe Wrench

The illustration shows a wrench for circular shapes, which grips by clamping and does not mar finished surfaces as there is no rough or knurled part to come in contact with the work. A number of clamps for different sizes can be made and used with the same lever or handle.



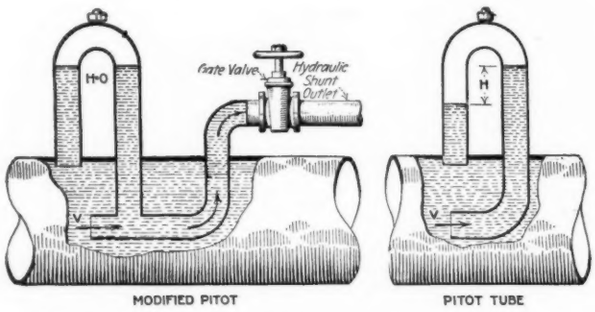
SMOOTH CLAMP WRENCH FOR FINISHED WORK

The clamps may be made of one piece or hinged as shown in the two designs. The greater the pull on the lever the harder the clamp will grip, but a slight motion in the opposite direction will release the work.

Brooklyn, N. Y. WILLIAM FORRAY.

Modification of the Pitot Tube

As a means or device for measuring the flow of liquids and gases, the pitot tube has long been in use, but it is only when used with the utmost care that results have proved uniform and reliable. It is evident that in the hands of different men the readings are variable, and the same tube may show different tip coefficients. A number of experimenters have worked on modified forms in an endeavor to reduce this variation in results. The modified pitot tube illustrated is so arranged that the water flowing into the impact tube is shunted or discharged into a reservoir and weighed, without interfering with the flow in the pipe to any extent, and H, the difference in the water level as in the ordinary tube, becomes zero. The velocity V at the tip will be equal to the amount of water shunted into the measuring container in a given time, divided by the tip-opening area—all quantities being measured in the usual units. Turbulent flow does not affect the tip coefficient. The coefficient of the tip may be considered unity under all conditions, although experiments show that variations of 1 per cent. may sometimes be encountered. The tip coefficient of the pitot tube as commonly used under similar conditions varies more than 4 per cent.



MEASURING FLOW WITH MODIFIED PITOT TUBE

Schenectady, N. Y. PETER J. M. CLUTE.

Shifted Motor Bearing Housings

If the brushes of a direct-current motor are shifted around the commutator an angle represented by one pole pitch, the direction of rotation of the armature will be reversed. This method of reversing has never been generally adopted probably because the simpler method of interchanging the field or the armature connections is more convenient and reliable. Occasions often arise, however, where the location of a motor must be changed from the side wall to the ceiling or to the floor, or vice versa. In such cases the end shields, which support the bearings, must be turned in order that the oiling devices may remain operative; in the shifting of the bearing housings and with them the brushes, errors of brush position are likely to arise.

In one instance there was complaint that a motor the position of which had been changed from the floor to a side wall could not be started. Investigation disclosed that the end shields had been turned a quarter turn in order to keep the oil boxes upward; but the brush yoke had also been turned with the shield, thereby bringing the brushes halfway between the poles of the two-pole

motor. The remedy was to loosen the setscrew that held the brush-holder yoke to the bearing housing and move the former back the same amount that the shifting of the shield had moved it forward.

In another instance the changing of a four-pole motor from the side wall to ceiling reversed the direction of rotation. This also was due to turning the yoke a quarter turn with the end shield, but as the motor had four poles, a quarter turn corresponded to the pole pitch, so that the motor ran, but in the opposite direction. The remedy was the same as in the preceding case.

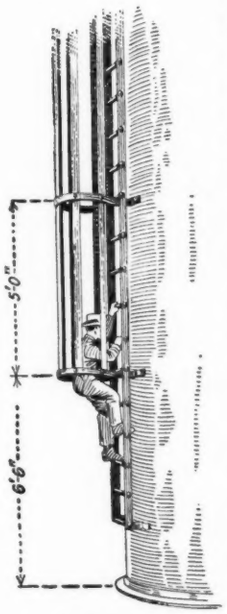
An operator stated that he had been assured, when he bought a certain motor, that it would operate equally as well on the wall or ceiling as on the floor, but when it was placed on the ceiling, oil would not stay in the bearings and that he wanted a motor that would do what it was guaranteed to do. Of course the trouble was that the motor had been turned without turning the end shields, so that the oil wells and bearings were upside down.

E. C. PARHAM.

Brooklyn, N. Y.

Safety Ladder for Smokestacks

Referring to the letter by H. B. McDermid in the issue of Oct. 16, page 538, describing a safety ladder for smokestacks, I submit an illustration of a safety-cage that I have seen on large stacks and other important work on which a stairway would be too expensive, which I consider better than the one previously described. It will be seen that for an equal degree of protection only a few hoop pieces are needed since the vertical guards extend the entire length of the ladder, and they are more easily made. Another advantage of this design is that one is not apt to strike one's head against any part of the structure as in the previous case. Should it be desirable to leave space to get outside of the inclosure, the guard rail next to the ladder can be placed far enough out to allow a man, not too corpulent, to squeeze through the opening without defeating the object of the guard. There certainly is no occasion for an accidental fall from a ladder guarded in this manner.



SAFETY GUARD

W. CONOTT.

Pittsburgh, Penn.

Blank Charts for Recording Instruments

In the Nov. 13 issue of *Power*, page 673, there is a suggestion relative to the saving of paper used as charts on recording instruments. The suggestion involved the use of transparent, unruled paper, which on being removed from the instrument would be placed over a standard ruled sheet to ascertain the values registered by the curve.

An improvement on this idea would be to use heavy paper for the record sheet and have a standard chart outlined on some durable transparent substance. Celluloid, which can be procured in any thickness, would serve admirably. The lines of the chart could be scratched on the celluloid (which is placed over the standard chart), using a heavy sharp-pointed needle. Figures could be transcribed in the same manner and the marks afterward gone over with india ink. The surplus ink could be wiped off before drying, leaving thin black lines and figures.

To use, the celluloid would be placed over the chart taken from the instrument, which had been marked for a time point when the blank was inserted.

Richmond, Va. JAMES M. PURCELL.

Water Heater Design

I have read with a good deal of interest the articles appearing in *Power* by Charles D. Allan, covering the design of hot-water heating under forced circulation. Much that Mr. Allan writes is very good, and as an engineer I feel that these articles are timely because the possibilities of hot-water heating are not fully appreciated. I regret, however, that some of Mr. Allan's figures are such that they challenge the accuracy of the whole article. Of course, the easy thing to do would be to let these points pass, but the engineer should have correct information along this as well as all other lines.

Although there has been great development along most lines, there has not been much in hot-water heaters, and a consulting engineer is seldom found who is capable of designing heaters, and little is found in engineering literature that is exact or a careful discussion of the designing of this class of apparatus.

Without entering into a detailed discussion, I would call attention to Mr. Allan's arbitrary use of 230 as a coefficent of heat transmission without anywhere telling why he uses this value. It is my personal conviction that if confronted with the question, "How did you arrive at this figure?" he could give no satisfactory answer, save that certain apparatus so designed was working satisfactorily, but this is hardly an engineer's answer. Investigations, and there have been a great many, show that the coefficient of transmission in apparatus of this kind is a function of the velocity, the usual formula being $K = AV$. A coefficient of 230 for heaters designed in accordance with Mr. Allan's plan might be too high, notwithstanding there are tests on record of apparatus where they have secured a coefficient as high as 1800. In this connection it is interesting to note that the feed-water heaters used by the Department of Steam Engineering in the United States Navy are designed on the basis of a coefficient of approximately 1000. Granting, then that 230 is correct for this particular design, would it not be pertinent to ask, "Why should the apparatus be designed in this way instead of in a way which would permit the use of a much higher coefficient?" This means that instead of a steam-tube heater a water-tube heater should be used.

Early in my engineering education it was explained to me that the difference between a mechanic and an engineer consisted in the fact that while a mechanic might make a piece of apparatus that would do the work, it required an engineer to make one that would not only work but that would be economical in cost; and, judged by this standard, Mr. Allan's design is that of a mechanic. The foregoing is written for the purpose of opening a discussion of the proper design of heaters. To illustrate the desirability of this, I would call attention to some of the specifications that are being issued. Recently, a Boston firm issued specifications for forced-circulation hot-water heaters to be used for a hospital building, in which the manufacturers are asked to guarantee the number of pounds of steam that would be required to heat a certain number of gallons of water from a given temperature to 210 deg., the inference being that some classes of apparatus might require more pounds of steam to do this work than others.

I think *Power* is the proper medium through which to call attention to these things, and if desired I will send the exact wording of some other absurd specifications.

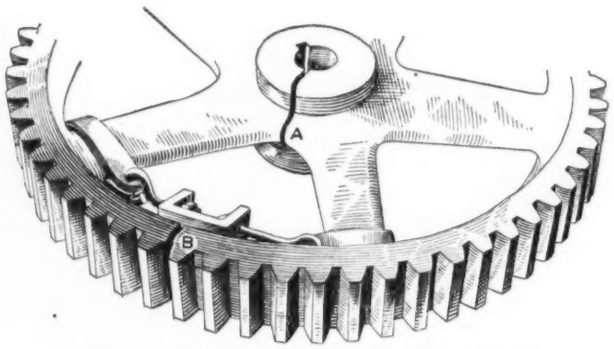
O. W. JACKSON.

New York City.

Broken Spur Gear Repaired

How we repaired a broken 4-ft. gearwheel at one of the coal mines in Canada far from the factory where we could have it renewed might interest someone in similar trouble.

The gear was broken because it was cast without provision being made against contraction strains. The wheel was taken off and cut through at *A* with a hacksaw. This was not done by hand, but an extension was rigged up to the power saw and a boy guided the



BREAK CAUSED BY UNEQUAL SHRINKAGE

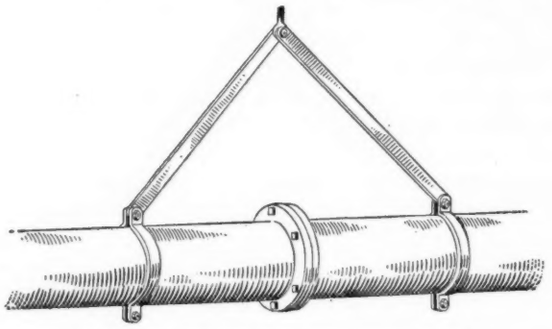
end of the saw frame. A wedge was inserted at *B* to prevent pinching the saw, and on taking out the wedge, it was found that the opening at *B*, sprung together, closed entirely. A turnbuckle was improvised out of a bolt and knee plate to go between the spokes with suitable bands, kept from sliding down the spokes, to hold the ends of the broken rim rigid. Rings were shrunk on the hub of the wheel, and after being filed out a trifle to fit the shaft, the wheel was put to work again and operated as quietly as when first installed.

Such wheels should be made with a split boss to avoid strain and should be clamped with bolts.

Banff, Albert, Canada. D. T. HARDY.

Support for Flanged Pipe

Mr. Cahen's special form of support for flanged pipe joints, as illustrated in the issue of Oct. 16, page 536, is excellent and might be used in special cases where construction requires hanging at certain points and at wide intervals. But why the curves and the quarter twist at the hanger? Why not make the two pieces of



HANGER MADE OF STRAIGHT BARS

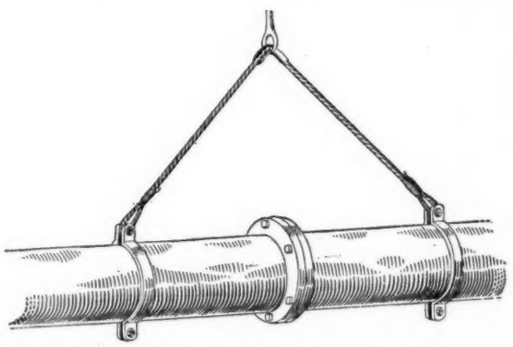
bar or strap iron straight and also save labor by bolting them to the hanger without the quarter twist? The strap might even be made in one piece with a 90-deg. bend at the point where it is bolted to the hanger.

In many installations, however, it would be easier to use two straight hangers, one on each side of the flange, costing only a little more and they would probably give better results.

LOREN L. HEBBERD.

Milwaukee, Wis.

A pipe support similar to those described can be made by the use of a cable or jack chain in place of rods, as shown in the illustration. It is a good plan to use a



SHORT END OF WIRE CABLE UTILIZED

piece of iron, formed as shown, in the eye of the hanger to distribute the strain better and to protect the cable.

West New York, N. J. L. V. LAUTHER.

Keeping Water from Steam Packing

On our pumping engines the tail rod of the steam cylinder is extended and is the pump rod, so that water is sometimes carried along to the steam packing. To prevent this I wrap a couple of turns of sash cord around the rod, after soaking it in water and drawing it through the hands to remove the dressing, and tie it to some fixed point so it will pull tight around the rod. I find that I get about three times the service out of the steam packing and also a better vacuum.

Colton, Calif. R. A. DAVIDSON.

Inquiries of General Interest

Superior Economy of Larger Engines—What are the principal reasons for larger engines being more economical of steam per horsepower than smaller ones? H. W.

The principal reasons are that permissible cylinder clearance, losses from radiation of heat, leakage, condensation and friction rapidly decrease in proportion as the size of the engine is increased.

Stretched Position of Valve Rod—In a Corliss engine-valve gear what is meant by the stretched position of a valve rod? R. G.

The rod is in the stretched position when the wristplate has swung far enough over to one side to place the rod on dead-center with the wristplate stud, so that the centers of the valve-rod pins and the center of the wristplate stud are stretched out in a straight line.

Relative Advantages of Flat-Slide and of Piston Valves—What are the advantages of a flat-slide valve over a piston form of valve? G. T. L.

A flat-slide valve and seat can be machined independently of each other, and a tight joint can be obtained between the valve and its seat without recourse to careful sizing or grinding. It will remain tighter with wear, and inequalities that develop in the valve face or seat usually can be removed by hand scraping. The piston form of valve is more readily adapted to the design of a balanced valve, requiring less power for its operation and is less likely to become warped so as to affect the tightness of the valve.

Steam Chargeable to Operation of Fuel-Oil Pump—In an oil-burning plant what proportion of steam generated is used for operation of a duplex pump for feeding oil to the burners? J. V.

On account of the small size of pump employed and the impossibility of filling the cylinders with oil at each stroke and the constant presence of more or less gas, the steam consumption per indicated horsepower and per cent. of slip are high. But under average plant conditions, less than 1 per cent. of steam generated would be required for operation of the pump, without credit for usual recovery of heat from the exhaust for heating the oil after it is discharged from the pump but before it reaches the burners.

Lost Motion in Duplex-Pump Valve Gear—In a duplex steam pump, what is meant by lost motion in the valve gear and how is it made use of for operation of the pump? A. D. K.

In a direct-acting duplex steam pump, the steam slide valve of each engine is operated by a rocker arm that receives its motion from the other engine. When the valve rod of one side has carried the valve to one end of its travel and the motion of the valve rod has been reversed by the motion of the piston rod of the other side of the pump, the amount of reversed motion that can be imparted to the valve rod or valve-rod connections without causing the valve to be moved is called the valve-rod lost motion. The less the amount of this lost motion the earlier the valve and piston will be started on the new reverse stroke and thus effect earlier reversal of the stroke that is taking place on the other side of the pump.

Pounds of Coal per Horsepower-Hour—Why is not steam-engine economy expressed in pounds of coal used per horsepower-hour in place of pounds of steam or pounds of water made into steam? G. T. L.

The engine is chargeable with the heat that it receives in the steam but is not responsible for the heat value of the fuel, the perfection of combustion or the evaporative efficiency of the boiler, all of which vary under different conditions. It is therefore illogical to express engine economy in pounds of coal except as the measure of performance when all conditions affecting the economy of generation and delivery of the steam to the engine and the quality of the steam supplied and back pressure on the exhaust are stipulated.

Computing Heating Surface of Tubes—Should the heating surface of a boiler tube be based upon the inside diameter or outside diameter of the tube? F. H. R.

The heating surface is the surface that receives the heat and therefore for water-tube boilers should be based on the outside diameter and for fire-tube boilers on the inside diameter of the tubes. Tube sizes are rated according to the outside diameter and, for greater convenience, approximate computations of the heating surface of fire-tube boilers are based on the external diameter of the tubes. The heating surface of a 3-in. tube (2.782 in. inside diameter) when based on the external diameter would be credited with about 7 per cent. more than the true heating surface.

Flow of Water Through Ajutage—What quantity of water per hour would be discharged into the atmosphere through a smooth pipe ¾ in. diameter and 12 in. long, projecting within a tank about 8 in., with the water at the entrance of the pipe under a head of 92 feet? L. R.

The theoretical velocity of flow in feet per second would be given by the formula $v = \sqrt{2gh}$, in which g = the acceleration due to gravity = 32.16, and h = head in feet. By substitution the theoretical velocity would be $v = \sqrt{2 \times 32.16 \times 92} = 76.9$ ft. per sec. The actual velocity of flow through an ajutage of the given form would be about 72 per cent. of the theoretical, or 72 per cent. of 76.9 = 55.4 ft. per sec., and for an ajutage ¾ in. diameter the discharge per hour would amount to,

$[(\frac{3}{4} \times \frac{3}{4} \times 0.7854) \div 144] \times 55.4 \times (60 \times 60) =$ 611.879 cu.ft., or $611.879 \times 7.48 = 4576.8$ gal. per hour.

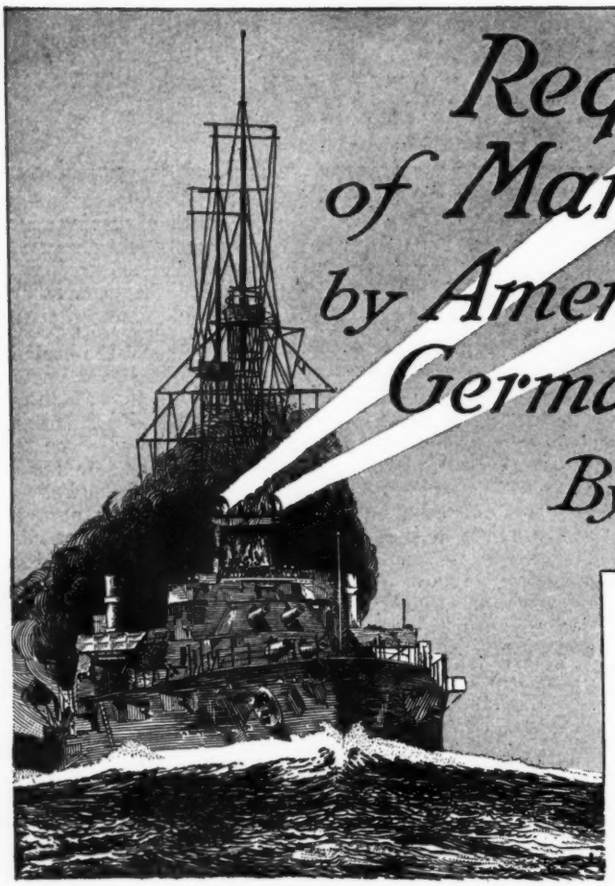
Utilization of Heat Radiated from Boiler—The space over our 72-in. x 18-ft. return-tubular boiler is 4 ft. 6 in. high and is inclosed by a concrete roof and side walls. Could not the heat of this space be utilized for warming rooms without increasing the amount of fuel required or reducing the steaming capacity of the boiler? D. H. H.

The present waste of heat is that which may be lost from transmission through the roof and side walls. By constructing an air space around the outside of the roof and side walls, fresh air at the present temperature outside of the present roof and walls may be introduced and conducted off as the vehicle of the heat at present lost by transmission and without materially affecting the present amount of output for fuel used by the boiler. But if the space above the boiler is utilized for receiving the fresh air, all the heat thus removed will be at the expense of additional fuel, excepting only the reduction of loss of heat through the roof and walls of the space over the boiler by reason of lowering the temperature of that space. No advantage can be taken of a reduction of this loss without depriving the boiler of heat at the expense of fuel, for with a lower temperature of the space above the boiler, there will be more rapid radiation of heat from the boiler.

ERRATA—On page 775, Dec. 4 issue, under "Allowable Pressure for Unstayed Heads," the substitutions in the formula should have been made so as to give:

$$\frac{3}{8} = \frac{5.5 \times \left(\frac{1}{0.60} \times P\right) \times 48}{2 \times 55{,}000} + \frac{1}{8}$$

from which $1760\,P = 110{,}000$ or $P = 62.5$ lb. per sq.in. working pressure for the weaker head.



Requirements of Marine Engineers by American, English and German Governments*

By Robert Haig†

THE seagoing engineer of today should possess a sound educated, mechanical knowledge of the construction and principle of the machinery placed in his charge. He should have a knowledge of fuel values in relation to coal or oil and a comprehensive grasp of what combustion actually means. He should know what corrosion means to metals and the preventable measures to adopt. He should understand the value of feed heating and the economies to be gained. He should understand what expansion of metals means and the risks that are run by turning live steam into cylinders or cold pipe lines not properly drained, or in raising steam in boilers in insufficient time. He should know what specific gravity, density of liquids and flash point of oils are in relation to his daily tasks, and to qualify him for the important duties he has to discharge.

For the purpose of comparison and interest, I have taken the requirements of the maritime bureaus of the American, English and German governments pertaining to seagoing engineers, which are as follows:

American (Department of Commerce, Steamboat-Inspection Service)

Requirements of Board of Supervising Inspectors:

34. Chief Engineers of Ocean Steamers—Any person holding chief engineer's license shall be permited to act as first assistant on any steamer of double the tonnage of same class named in said chief's license.

Engineers of all classifications may be allowed to pursue their profession upon all waters of the United States in the class for which they are licensed.

First Assistant—Engineers of lake, bay and sound steamers who have actually performed the duties of engineer for a period of three years shall be entitled to examination for engineer of ocean steamers, applicant to be examined in the use of salt water, method employed in regulating the density of the water in boilers, the application of the hydrometer in determining the density of sea water, and the principle of constructing the instrument; and shall be granted such grade as the inspectors having jurisdiction on the Great Lakes and seaboard may find him competent to fill.

Any first assistant engineer of steamers of 1500 gross tons or over, having had actual service in that position for one year, may, if the local inspectors in their judgment deem it advisable, be licensed as chief engineer of lake, bay, sound or river steamers of 750 gross tons or under, in which case license shall be issued on chief engineer's form of license, which shall be indorsed with authority to act as first assistant engineer of steamers of any tonnage for which he is qualified.

Any person holding a license as first assistant engineer, and having had experience as first assistant engineer for a portion of the year required for raise of grade, may substitute experience as second assistant engineer, while holding first assistant engineer's license, which experience as second assistant engineer shall only count as one-half; provided, that any person having had a first assistant engineer's license for two years, and having had two years' experience as second assistant engineer, shall be eligible for examination for chief engineer's license.

Second Assistant—Any person holding a license as second assistant engineer, and having had experience as second assistant engineer for a portion of the year required for raise of grade, may substitute experience as third assistant engineer, while holding second assistant engineer's license, which experience as third assistant engineer shall only count as one-half; provided, that any person having had a second assistant engineer's license for two years, and having had two years' experience as third assistant engineer, shall be eligible for examination for first assistant engineer's license.

Third Assistant—First, second and third assistant engineers may act as such on any steamer of the grade of which they hold license, or as such assistant engineer on any steamer of a lower grade than those to which they hold a license.

Any person holding a license as third assistant engineer and having had twelve months' experience as junior engineer, or twelve months' combined service as third assistant engineer and junior engineer, or two years' experience as oiler or water tender, or two years' combined service as oiler and water tender, since receiving said license, shall be eligible for examination for license as second assistant engineer.

Inspectors may designate upon the certificate of any chief or assistant engineer the tonnage of the vessel on which he may act. (Sec. 4441, R. S.)

*From a paper, "Progress of Marine Engineering and the Education of the Marine Engineer," read before the November meeting of the Society of Naval Architects and Marine Engineers, New York City.

†Member of the society.

Qualifications required by British Board of Trade for the various grades of marine engineers (ordinary certificates):

25. Value of Ordinary Certificates—Ordinary certificates will entitle the holders to go to sea in the grade certified as engineers of any vessel in the British mercantile marine.

26. Second-Class Engineer—A candidate for a second-class engineer's certificate must not be less than 21 years of age.

(a) He must have served as an apprentice engineer for four years at least, and prove that during the period of his apprenticeship he has been employed in the manner set forth.

Journeyman's time will be considered as equivalent to apprenticeship.

Every applicant must produce testimonials of ability as an engineer workman to the satisfaction of the Board of Trade.

If the candidate has served as an apprentice engineer or as journeyman, under the conditions above prescribed, for less than four years, he will be required to make up the deficiency or to complete this period of four years by service as engineer at sea on regular watch on the main engines or boilers of a foreign-going steamer.

If the candidate has not served at all as apprentice engineer or as journeyman, he will be required to have served at sea, in lieu thereof, as engineer on regular watch on the main engines or boilers, six years in a foreign-going steamer.

(b) In addition to the apprenticeship as above described, or the alternative sea service, the applicant must have served one year at sea as engineer on regular watch on the main engines or boilers of a foreign-going steamer, or 18 months in a home-trade steamer.

On and after Jan. 1, 1915, the applicant will be required, in addition to the apprenticeship above described or the alternative sea service, to have served 18 months at sea as engineer on regular watch on the main engines or boilers of a foreign-going steamer, or 27 months in a home-trade steamer.

(c) He must be able to give a satisfactory description of boilers and the methods of staying them, together with the use and management of the different valves, cocks, pipes and connections.

(d) He must understand how to correct defects from accident, decay, etc., and the means of repairing such defects.

(e) He must understand the use of the water gage, pressure gage, barometer, thermometer and salinometer, and the principles on which they are constructed.

(f) He must be able to state the causes, effects and usual remedies for incrustation and corrosion.

(g) He must be able to explain the methods of testing and altering the setting of the slide valves, and method of testing the fairness of shafts and adjusting them.

(h) He must be able to calculate the suitable working pressure for a steam boiler of given dimensions and the stress per square inch on crank and tunnel shafts when the necessary data are furnished.

(i) He must understand the construction of steering engines, evaporators, feed filters and feed heaters.

(j) He must understand the construction of centrifugal, bucket and plunger pumps, and the principle on which they act.

(k) He must be able to state how a temporary or permanent repair could be effected in case of derangement of a part of the machinery or total breakdown.

(l) He must write a legible hand and have a good knowledge of arithmetic up to and including vulgar and decimal fractions and square root. He must also understand the application of these rules to questions about safety valves, coal consumption, consumption of stores, capacities of tanks, bunkers, etc.

(m) He must be able to pass a creditable examination as to the various constructions of paddle and screw engines in general use; as to the details of the different working parts, external and internal, and the use of each part.

(n) He must possess a creditable knowledge of the prominent facts relating to combustion, heat and steam.

27. First-Class Engineer—A candidate for a first-class engineer's certificate must be not less than 22 years of age.

In addition to the qualifications required for a second-class engineer, (a) He must:

(1) Have served at sea for 12 months with a second-class certificate of competency or service, on regular watch on the main engines or boilers of a foreign-going steamer.

(2) Have served at sea for 18 months with a second-class certificate of competency or service, as first engineer of a home-trade steamer, or two years with a second-class certificate of competency or service as second engineer of a home-trade steamer.

(3) Have served 2½ years with a second-class certificate of competency or service as third engineer of a home-trade steamer, if, during the whole of that period, he has been the senior engineer in charge of the whole of a watch on the main engines and boilers; or

(4) Possess, or be entitled to, a first-class certificate of service.

On and after Jan. 1, 1915, the candidate will be required, in addition to the qualifications required for a second-class engineer:

(1) To have served at sea for 18 months with a second-class certificate of competency or service, on regular watch on the main engines or boilers of a foreign-going steamship, as senior engineer in charge of the whole watch; or

(2) To have served at sea for 27 months with a second-class certificate of competency or service as first engineer of a home-trade steamer, or three years with a second-class certificate of competency or service as second engineer of a home-trade steamer.

(3) To have served three years nine months with a second-class certificate of competency or service as third engineer of a home-trade steamer, if, during the entire period, he has been the senior engineer in charge of the whole of a watch on the main engines or boilers; or

(4) To possess, or be entitled to, a first-class certificate of service.

(b) He will be required to make an intelligible hand sketch or a working drawing of some one or more of the principal parts of a steam engine, and to mark in without copy all the necessary dimensions in figures, so that the sketch or drawing could be worked from.

(c) He must be able to take off and calculate indicator diagrams.

(d) He must be able to calculate safety-valve pressures and the strength of the boiler shell, stays and riveting.

(e) He must be able to state the general proportions borne by the principal parts of the machinery to each other, and to calculate the direct stress, the torsional stress and the bending stress in round bars, and the direct stress and the bending stress in rectangular bars with given loads.

(f) He must be able to explain the method of testing and altering the setting of the slide valves, and to sketch about what difference any alteration in the slide valve will make in the indicator diagram and also the method of testing the fairness of shafts, and of adjusting them.

(g) He must be conversant with surface condensation, superheating and the working of steam expansively.

(h) His knowledge of arithmetic must include the mensuration of superficies and solids and the extraction of the square and cube roots, and the application of these rules to questions relating to the power, duty and economy of engines and boilers, and to the stresses in rods, shafts and levers of the engine. He should also be able to calculate the effect of the application of the lever, pulley, inclined plane and other mechanical powers.

(i) He must understand the construction of, and be able to maintain in working condition, the auxiliary machinery which is placed under his charge; namely, refrigerating machinery, electric-light engines and dynamos, electric motors fitted to ships' boats, hydraulic machinery and the various descriptions of steering engines, etc.

28. First-Class Certificates Without Second—The Board of Trade may see fit to allow an applicant who, in consequence of service abroad, has had no opportunity to obtain a second-class certificate, to be examined for a first-class certificate although he does not possess a certificate of the lower grade, provided he is able to satisfy them as to the satisfactory character of his services, but these should be ample both as regards length and experience.

If any candidate, who has not got a second-class certificate of competency, fails to pass the examination for the first-class certificate, but passes that for the lower grade, he may be given a second-class certificate of competency, but no part of the fee will be returned. A candidate who has been permitted to be examined for a first-class certificate without first obtaining a second-class certificate of competency or a certificate of service, and who fails in his examination in practical knowledge, may not be reëxamined for a certificate of the higher grade until he has served three months as watchkeeper with a second-class engineer's certificate of competency or service as required by the regulations. If the candidate fails in practical knowledge both for the lower as well as for the higher grade of certificate, he may be reëxamined for a second-class certificate only, subject to the usual regulations relating to failure.

29. Extra First-Class Engineer—This examination is voluntary and is intended for such persons as wish to prove their superior qualifications and are desirous of having certificates for highest grade granted by Board of Trade.

30. Extra Examinations, When Held—The extra examinations are held once in every three months, and at ports where examinations of engineers are ordinarily conducted. The examination extends over several days. According to present arrangements these examinations will begin on the second Tuesday in January, April, July and October in each year.

31. Notice Required—Notice must be given by the candidate at least one week before the day on which the examination begins, and these notices must be immediately reported by the examiners to the chief examiner in London.

32. Qualification Required—A candidate for an extra first-class engineer's certificate must have served an apprenticeship of five years at least or, as an equivalent, three years' apprenticeship and three years at an approved technical school; or he must have served for one year at sea on regular watch on the main engines or boilers as senior engineer in charge of the whole of the watch while holding a first-class engineer's certificate.

(a) He must be able to write good English.

(b) He must possess a thorough knowledge of the construction and working of the different forms of marine engines and propellers in all their parts, and be so far acquainted with the fundamental principles of theoretical and applied mechanics as to comprehend the general principles on which the machine works, and to illustrate his knowledge of these principles by numerical examples.

(c) He must possess a knowledge of the theory of strain and stress sufficient to be able to deduct the ordinary rules for the bending of rectangular bars and for the twisting and bending of round bars.

(d) He must be acquainted with the principles of expansion and the modern theory of heat, and be able to solve, with the assistance of his own books or without books, according as the examination papers may be set, questions in economy and duty in connection with engines and boilers.

(e) He must understand how to apply the indicator and to draw the proper conclusions from the diagrams, and to construct the approximate diagrams for any given data.

(f) He must be able to produce, without a copy, a fair working drawing of any part of the machinery with figured dimensions fit to work from.

(g) He must understand the principles of the action of the screw propeller and the paddle-wheel, and must be able to estimate numerically the effect in speed of ship and consumption of fuel due to any alteration in pitch, diameter, revolutions, etc.

(h) He must be able to give a description of boilers and the methods of staying them, and must show that he possesses a knowledge of the theoretical principles which regulate their construction, and that he is able to calculate the strength of the boiler shell, stays and riveting.

(i) He must understand the general nature of the strains and stresses produced by the steam pressure, and by the expansions due to unequal temperatures in boiler shells.

(k) He must have a knowledge of safety-valve construction, and the principles involved in determining the size of a safety valve, and the construction of spring-loaded and dead-weight valves.

(l) He must possess a thorough knowledge of the theory of combustion, the chemical composition of fuels, the evaporative duty of fuels of given composition; the production of draft; the effect in regard to economy, safety and wear and tear, of increasing or diminishing the proportion of heating surface of grate-bar surface, of area of section of air passages, of area of water surface, of steam-space capacity and water capacity.

(m) He must be able to explain the formation of scale and the precipitation of salt, and the precautionary means adopted in respect thereto, with jet condensers and with surface condensers.

(n) He must understand the general principles involved in the construction of the barometer, thermometer, salinometer and steam and vacuum gages.

(o) He must be familiar with the general results obtained from past experience in relation to corrosion, pitting and galvanic action in boilers, and the use of zinc and of soda in boilers.

(p) He must be able to give a variety of illustrations of how defects have arisen from accident, imperfect construction or deterioration, and how these defects may have been prevented, and the best way of repairing such defects.

(q) He must be familiar with the properties and processes of manufacturing and testing the ordinary materials used in the construction of machinery and must possess an intelligent knowledge of the properties of the lubricants, boiler cements and india rubber in general use in steamers.

(r) He must understand the causes of spontaneous combustion and the formation of explosive gases in coal holds, and the precautionary measures proper to prevent accidents from these causes.

(s) He must be acquainted with the principles and practice of the generation and application of electricity to various purposes on board ship.

(t) He must be able to explain the construction and working of the refrigerating machinery in use on board ship, the electric-lighting plant, the steering engines, hydraulic and pneumatic engines, the pumps, and all other auxiliary machinery placed under the chief engineer's control.

(u) In order to deal intelligently with ballast tanks, the cocks, valves and pumps of which are under the chief engineer's control, and to coöperate the more readily with the master in keeping the vessel in a safe condition, especially when she is light, and when coaling operations are proceeding, candidates are expected to possess an elementary knowledge of the stability of floating bodies.

(v) He must possess a practical knowledge of ship construction, and understand the elementary principles involved, so as to be able to deal with engine and boiler seatings and to supervise and direct any repairs that may be required to an iron or steel ship.

If the candidate does not obtain 67 per cent. of the total number of marks allotted for the papers he will be declared to have failed. The papers will be founded chiefly on the foregoing subparagraphs.

33. On and after Jan. 1, 1915, a candidate for either a second-class or a first-class certificate, who within two years from the date of application to be examined has attended an approved course comprising general mathematical and scientific instruction at a technical school recognized by the Board of Trade as suitable for the training of marine engineers, will be allowed to count time so spent as equivalent to sea service in the ratio of three months at the technical school to two months at sea. Time so spent cannot be accepted as equivalent to more than one-sixth of the total sea service required for either certificate, but a candidate who has been allowed to count such time on examination for a second-class certificate will not be debarred from counting similar subsequent time on examination for a first-class certificate.

Time spent in an approved marine technical school subsequent to obtaining a first-class certificate and within two years from the date of application to be examined may also be accepted as forming part of the qualifying service required under paragraph 32, in the case of candidates for extra first-class certificates, but if such time is substituted for sea service, it will only count as equivalent thereto in the ratio of three months at the school to two months at sea

In every case in which an allowance is made for time spent at a marine technical school, the candidate will be required to produce the principal's certificate for continuous and regular attendance at all the approved classes and for satisfactory progress.

Certificates for engineers of home-trade passenger ships propelled by oil engines:

34. Oil-Engine Certificates—Candidates may be examined for second-class certificates of competency as engineer of vessels propelled by oil engines.

These certificates will entitle the holders to go to sea as second-class engineers of home-trade passenger ships propelled by oil engines, but will not entitle them to go to sea as second-class engineers of foreign-going ships or of home-trade passenger steamships.

35. Second-Class Engineer (Oil Engines)—A candidate for a second-class oil-engine certificate must be at least 21 years of age. (a) He must prove:

(1) Four years' experience at the making or repairing of machinery, of which at least six months must be at the making or repairing of oil engines; or

(2) Three and a half years in charge of engines and boilers at sea or an equivalent suitable experience on shore.

And in addition to either (1) or (2):

Six months' experience with oil engines at sea.

Note: Alternative service to the above may be considered, but it is essential that the candidate should have experience with oil engines, and have spent at least six months at sea in the engine room of a seagoing vessel.

(b) He must write a legible hand, and have a good knowledge of arithmetic up to and including vulgar and decimal fractions and square root.

He must also understand the application of these and other rules to problems relating to spring- and lever-loaded relief valves, and be able to solve questions about the relative speeds of a vessel at different revolutions, the capacity of oil tanks, etc.

(c) He must be able to give a clear explanation of the principle on which an oil engine works, and to show by means of illustrative sketches and otherwise that he understands the construction of those in general use.

(d) He must be able to describe the chief causes which may make the engine difficult to start, and to explain how he would proceed to remedy any defects.

(e) He must be able to show that he understands the mechanism of the starting and reversing arrangement, and is competent to deal with defects which may lead to failure in the prompt handling or reversing of the engine.

(f) He must have sufficient mechanical ability to be able to overhaul the engine, to adjust the working parts, and to put the engine together again in good working condition.

(g) He must be able to give satisfactory answers to the elementary questions numbered 305 to 310 inclusive in Appendix C.

(h) He must be able to prove (by actual trial if practicable) that he is competent to manipulate an oil engine when under way by starting, running the engine, stopping, reversing or slowing down.

(i) He must understand what is meant by the flash point and have a knowledge of the explosive properties of the oil generally used in engines when exposed in the open air and the danger of exposing any vapor from the oil to a light or of allowing any leak from the oil tanks, particularly into the vessel's bilges.

(j) He must understand the action of wire gauze diaphragms when placed in pipes and connections to oil tanks, etc., for the purpose of preventing the explosion or ignition of oil vapor therein.

(k) He must be able to take the necessary precautions to guard against the escape of inflammable vapor from the vaporizers when the engines are stopped.

(l) He must be able to explain the principle and construction of a dynamo and the construction and arrangement of primary and secondary batteries and induction coils, so far as is necessary for the efficient management of an oil engine.

36. Workshop Service—Workshop service must have been performed in works where steam engines, boilers, etc., are made or repaired, but no time served before the age of 15 will be counted.

Not less than two years of the apprentice time must have been spent at fitting, erecting or repairing engines and machinery either in the works or outside. The remaining two years may be made up of time spent in engine works at fitting, erecting or repairing engines and machinery or at one of the other branches of the trade given below, or at an approved technical school (day), the time so spent to count as follows:

Fitting, erecting, repairing or turning	Full time
Working in drawing office	Full time up to one year, and beyond one year one-half time
Patternmaking	One-half time with a maximum allowance of one year
Planing, slotting, shaping and milling	One-third time
Boilermaking or repairing	One-half time
Smith work	One-half time with a maximum allowance of one year
Coppersmith work	One-third time with a maximum allowance of six months

In the event of the apprentice time being extended to five years or more, four years at machining followed by one year at erecting may be accepted as qualifying.

37. Workshop Service Other Than the Above—When the workshop service has been performed in a place where engines are made, but not in the manner specified in paragraph 36, the case must be referred to the Board of Trade with a report upon the service performed. If the service be such as is useful training for an engineer, the board may accept the service; but in every such case the applicant must prove additional engine-room or marine-engine workshop service as required in the succeeding paragraph.

38. Workshop Service Where Engines Are Not Made—When the workshop service has been performed in a place where steam engines are not made or repaired, and the class of work done is similar to that required in engine making, the service may be accepted with an additional year of qualifying service; that is, four years' workshop service and either two years at sea on regular watch, or one year at engine fitting in a suitable marine-engine workshop and one year at sea in the engine room. The approval of the Board of Trade must be obtained in every such case before the candidate is examined.

39. Technical Schools—Time spent after the age of 15 at a technical day school (recognized by the Board of Trade as suitable), where there is an engineering laboratory, may be taken into account and accepted as equivalent to artisan service, usually at the ratio of three years in the technical school to two in artisan service, provided the applicant has taken the full engineering course and can produce the principal's certificate for regular attendance at all the approved classes and for satisfactory progress; and provided also that the remaining portion of the time has been spent in works where steam engines, boilers, etc., are made or repaired, in accordance with the scale of values indicated above.

40. Sea Service—The sea service required by these regulations is, unless otherwise stated, service performed in foreign-going ships of at least the nominal horsepower specified for the respective grades of certificates. The nominal horsepower, as given on the vessel's certificate of registry, may in all cases be accepted by the examiners.

41. Qualifying Service Defined—In the case of candidates for first-class certificates qualifying service means, as a rule, service on regular watch on the main engines or boilers as senior engineer in charge of the whole watch. When, however, three or four engineers are on watch at the same time the service of the two seniors may be allowed to count, and when not less than six engineers are on watch together that of the three seniors, provided the certificate from the superintending engineer is produced stating the number of engineers on watch, the rank held by the applicant and that he was in full charge of a watch on a definite section of the main engines or boilers. During the whole of the period claimed, candidates must have been in possession of second-class certificates.

In the case of candidates for second-class certificates qualifying service means service as engineer on regular watch on the main engines or boilers.

In no case will time spent in clerical work be allowed to count.

42. Further as to Qualifying Service—Only such service as gives the experience required to make a man thoroughly competent as a seagoing engineer is accepted as qualifying service. Even for a second-class certificate the candidate must prove to the satisfaction of the examiner that he is qualified by experience and knowledge to act as chief engineer in an under-powered steamer of 99 nominal horsepower on a voyage, say from England to Egypt, taking full responsibility for engines and boilers.

GERMAN (MARINE ENGINEERING BUREAU REQUIREMENTS)

For admission to the examination for engineers of the second class it is required as follows:

During apprenticeship, must attend evening classes to study the theory of engineering and learn English.

After the fifteenth year of age: Either (a) One must serve 72 months in steam-engine or motor-construction works, in steam-engine or motor-repair works and on the engineering staff of ocean steamers; at least 36 months must be spent in steam-engine or motor works, and at least 24 months on the engineering staffs in voyages of suitable steamers as assistant engineers; or

(b) After passing the examination for third-class engineer one must spend at least 24 months as engineer, and either before or after the examination for third-class engineer must have spent at least 36 months as machinist and blacksmith in steam-engine or motor works.

For admission to examinations for first-class engineer one must serve for at least 24 months after passing the examination for second-class engineer, in voyages of suitable steamers as engineer in short, medium or great voyages.

For admission to the preliminary examination for marine engineer (chief engineer) it is required:

After passing the fifteenth year, one must have spent at least 66 months in machinery construction work in one of the larger construction firms for marine engines, and at least 36 months on the engineering staff of steamers. At least 36 months must be spent in one of the larger steam-engine works, of which six months must be spent in the blacksmith and brazier shops. At least 30 months must be spent on the engineering staff of suitable ocean steamers as assistant or in a higher position in short, medium or long voyages.

The time spent in short voyages is limited to 12 months.

Besides, a 12 months' course at a technical marine engineering school recognized by the state is required.

For final examination for chief engineer, it is required:

After passing the examination for engineer of the first class, or after passing the preliminary examination for chief, one must spend 24 months in voyages of suitable steamers as engineer in medium and long voyages.

Besides, a 12 months' course of the upper class of a marine-engineering school recognized by the state is required.

The approval of the technical schools is in the hands of the Central State Board in conjunction with the Imperial Chancellor.

For candidates for second-class engineer, only that time is counted which is spent in steam-engine construction or repair works in its occupation of smith, brazier, machine builder and fitter. The time of service in the forging and brazing shops is limited to six months.

If one has passed the preliminary examination for chief engineer, he receives the certificate of engineer of the second class, and after ocean service of 24 months as engineer in short, medium or long voyages without further examination he receives the certificate of engineer of the first class.

Authority for the bestowal of the certificate of machinist of the first class belongs to a qualified State Board for the examination of qualifications; which considers in addition to the qualifications shown by passing the preliminary examination for marine engineers, the proficiency as a second-class engineer, as well as the time served at sea.

Note: The writer regrets that for obvious reasons it has been quite impossible to get reliable detailed particulars of the German engineering examinations.

It is not intended that we should produce an engineering theorist, but it is claimed that facilities should be provided for men, offering both educational and mechanical training of such a nature as to properly equip them for the duties of a marine engineer.

To properly equip men to become lawyers or doctors, splendid schools and institutions are provided in every large city which insist upon years of the highest educational training, and it is right that it should be so, otherwise a continuous supply of men of the proper caliber could not be assured.

Although education in general in this country is easy to obtain and is of the finest kind, yet extremely little is required of the engineer when he submits himself for examination as a test of his qualifications for the position he aspires to hold. The examinations and tests he has to pass are elementary and perfunctory to the last degree, entirely out of date in their requirements and out of touch with modern engineering. The tests and examinations should more adequately represent the educational and engineering necessities of the present day. Facilities should be provided by the Federal Government in those cities that are important shipping centers, so that the proper training be placed within the reach of those who desire to study marine engineering. It would then be proper to require that the Government examinations should be uniform and to the point aimed at, and further, should be such a standard and of such a searching nature that only men of at least a fair education and good mechanical training could hope to pass the examinations.

This would not entail any hardship if certain specified educational institutions included in their day and evening classes (with a view to training marine engineers) such subjects as mechanical drawing, algebra, physics, taking up heat values, combustion, refrigeration, strength of materials, electric light, powers, etc., all with direct relation to and including an exhaustive study of the various types of marine engines, boilers, etc.

Facilities should be provided at a nominal rate to make it possible for this technical training to be acquired during the apprenticeship period, and thereby produce a better-informed mechanic, and also for the seagoing engineer when he comes ashore to prepare and qualify himself for further examinations.

It should be required that men desiring to follow the profession of seagoing engineers meet the following requirements before going up for examination:

1. The candidate for examination should be a citizen of the United States.
2. He should be not less than 21 years of age.
3. He should be able to read and write English fluently and be educated equal to the senior classes in the public schools.
4. He should have served not less than 3½ years learning to be a machinist or as a machinist, inclusive (if possible) of one year in the drawing office, with a firm building marine engines and boilers; or

He should have served not less than four years learning to be a machinist or as a machinist with a firm engaged in repairing marine engines and boilers; or

He should have served not less than three years learning to be a machinist or as a machinist with a firm engaged in general engineering work with 1½ years additional in a shop engaged in marine engineering.

This would go a long way to insure a man whose hands had been trained and who had learned the functions of the essential parts of the marine engine.

The complex and exacting duties of the engineer on watch amply demonstrate that we can no longer afford to recruit our engineers from the men who come up through the stokehold. Such a condition is neither desirable nor fair to the men, the shipowner, or the costly property placed in charge of the engineer.

Today American engineers are paid the highest wages, and the shipowner has a right to expect in return that an engineer holding a government certificate should be a highly capable and efficient officer worthy of the responsibilities of his position.

It would be well for the engineering industry to establish on a reasonable basis, conditions both as to actual training and remuneration during a period of apprenticeship that would attract good types of young men. It is unfortunately all too true that apprenticeship in the past has largely meant only a period of work, with very meager remuneration and little or no attempt made to train him, with the result that

he became a good or bad mechanic according to his natural ability.

Lately, conditions have somewhat improved, but much more can be done; the apprentice ought to get actual instruction in his work, and encouragement to study should be given so as to develop his taste for the work. The employer will quickly get a return for this effort, as he will get the product of a man who has been taught to use his head. Had this line been more widely followed in the past, there would not be such a dearth of skilled mechanics today.

It is respectfully submitted that this society and other kindred societies should by discussion, representation and every other means within their power, impress upon the Government the extreme importance that the examinations, tests, qualifications and training of the seagoing engineer of the mercantile marine should be brought up to date and placed on a plane with that of other professions, whose responsibilities may be different in kind, but do not exceed in degree that of the men in whose hands are placed the care and management of the machinery of our merchant ships, so vital to the country's welfare at the present time.

Conservation in the Use of Coal

Bulletin No. 2, issued by the Committee on Coal Conservation of the Chamber of Commerce of the United States, to owners and managers of power plants, gives the following practical advice:

Costs of production have more attention today than ever before. The cost of coal for generation of power has in many instances not had the same consideration as other costs, because coal has been cheap and obtainable in abundance; cheap coal and cheap labor sometimes made it apparently economical in dollars and cents to install and run an inefficient plant.

Coal has now become expensive. It is hard to obtain. Efficiency in its use and avoidance of waste have become of first importance, since without power other materials cannot be utilized.

These conditions make it imperative for every owner or manager of a power plant to examine into the cost of the power his establishment uses, the economy with which it is generated and applied, and the increase in efficiency that is possible. Some of the steps that an owner or manager should take are:

Find the nearest source of coal that will meet the requirements, even if it does take a little more trouble to use it; the tax on the transportation system will thus be reduced so far as haulage by rail is shortened; coal is mined in 26 states, and these states extend practically across the continent and from the northern to the southern borders.

Give to the power plant and its personnel recognition and encouragement such as is due an expert and important department, thus getting new effort and attention to offset the extra attention and care needed with coal inferior in grade and preparation to the coal formerly available.

Seek to increase skill and proficiency in the men who handle the coal; a fireman at a hand-fired boiler shovels three to ten tons of coal a day—as great a value in material as many skilled men in other departments.

Put the fuel-using equipment into as perfect condition as possible; provide at hand-fired plants an ample firing floor with a good surface, together with a smooth-bottomed coal car if it can be used; eliminate leaks in the boiler setting, see that fire-doors fit properly, replace defective grate bars, make sure that smoke connections are clean and tight; if mechanical stokers are used, see that they are in good repair and that directions for using them are being followed; in general, make the plant and the fire-room of such character that an efficient man will stay on the job.

Install simple and convenient means by which the fireroom force may see results; scales for weighing fuel and ash, meters for measuring water fed to the boiler, and devices for determining the quality of flue gases, the draft over the fire, etc., can be made to interest the men in the fireroom and show the actual results of efforts to economize; one convenient means for operating the flue damper must be installed.

Endeavor to run boilers in service at their capacity; if efficiency is increased, one or more boilers in a battery may be dropped.

Provide water that is free from scale by using, when necessary, water-treating devices if the plant is large and special feed-water heaters in small plants.

Reduce loss of heat after it is generated; see that boiler surfaces and steam pipes are properly covered; the simplest and most inexpensive covering will reduce loss by 80 per cent.; in the engine room cut out useless steam lines, have valves properly set, reduce the small auxiliary pumps, etc., to a minimum, provide the repairs the engineer has been asking.

Obtain expert advice; good steam engineers are familiar with well-tried ways of reducing both consumption of coal and consumption of heat; their advice should be obtained in all practical cases; this is not a time for radical innovations but for utilizing tried experience.

One pound of coal per hour has yielded a horsepower per hour. That is the record of present possibility. It cannot by any manner of means be attained by every plant. But the fact that at present the average attainment throughout the country is but one-third or one-fourth of this record is indicative of the possible savings that can be made if the care and attention which the power plant deserves are actually given to it.—*The Valve World.*

Lightless Nights

The United States Fuel Administration has put in effect a definite plan for "lightless nights" throughout the country. It is proposed to darken all outdoor lighting other than street lights and special municipal lights needed for police purposes, on Sunday and Thursday nights of each week. The plan provides for radical changes in the order put out on Nov. 9, last, which restricted illuminated signs to certain hours, making such exceptions of merchants' and theater signs as seemed reasonable. In actual application, it now appears, this order is impracticable. The streets of cities are virtually as light as before these special signs were darkened. State Federal fuel administrations in New York, Illinois and other states have reported in detail on the impossibility of getting results from the old order. They say it is the tens of thousands of small signs that count.

"Lightless nights" would save coal in large quantities, according to the figures before the Fuel Administration. It would be a part of the plan to show every citizen the war necessity and have him join in the saving. In every residence, apartment house and office building people would be asked to use not more than one-half the usual lighting. Under the conditions noted in the November order the "white ways" have kept their brilliancy and the coal saving has not been large; under the new plan the "white ways" would disappear entirely on certain nights.

Fuel Conservation Campaign in Iowa

The National Association of Stationary Engineers of Iowa, according to Royal H. Holbrook, state deputy of the association, has inaugurated a state fuel-conservation campaign that is the most extensive movement thus far proposed in any state. It is intended to send men to any community, large or small, that makes a request for a visit. A few of the most important test instruments will be taken along, such as a Bacharach pocket CO_2 machine, a draft gage, a thermometer for about 800 deg., some charts for firing illustrations, and lantern slides, so that the engineers and firemen may have one meeting and the general public another. An intensive press campaign will be put on in all state papers and a still more intensive plan in the city or community visited. The intention is to visit every plant, be it boiler or furnace, that sends in a call. The list is usually made in advance by the secretary of the commercial club, which is in most cases responsible for the local expenses. In every city where there is an N. A. S. E., they will arrange for a campaign meeting in case it is not on the regular meeting-night program.

At the request of Ames College, which is responsible for the talent, Mr. Holbrook has undertaken to get the help

of the big men of the association, who will go in groups of twos or threes and stay from three to six days in a place, according to the locality and conditions. Mason City and Algona have been visited. Council Bluffs and Shenandoah are next on the list. The campaign has the backing of the Government through its fuel administrator for Iowa, Charles Webster.

It is a commendable movement, and Mr. Holbrook says the people are taking to it with enthusiasm. The campaign slogan is, "Save a shovelful of coal a day in a furnace in a house and you will help Iowa to save 500,000 tons of coal."

Municipal Lighting Plants in California

From Pasadena, Riverside and other cities of California where municipal electric-lighting plants or distributing systems have been instituted, surprising reports are received of the success attained, says the Santa Barbara *News*.

The City of Riverside has been operating an electric-distributing system for the last 21 years, by which it supplies all the electric current, not generated by parties who generate for their own requirements, used within the city. The city has always purchased the greater part of electric energy from privately owned water-power plants.

The cost of the original plant was $84,826.97. The interest on this amount and $38,000 has been paid out of the earnings, as has the cost of all extensions, improvements, depreciations and operating expenses of every kind, except $6330.70 received from the city's general fund when the plant first began to operate, and $85,951.90 which has been received from property owners for line and street light extensions. The surplus from the earnings is $393,799.04. Over $110,000 has been transferred to the city general fund and to gratuities. There is at present in reserve for depreciation $66,401.91.

Rates at Riverside have been reduced from 16c. in 1896 to an average rate for all current sold in 1916-17 of $0.0323. per kw.-hr.; the street-lighting rate for current only is $0.015 per kw.-hr.; for repairs and maintenance and current expense for the last year, $0.0217 per kw.-hr. The city's electric department pays for all depreciation expense of the street-lighting system which it owns.

The valuations given were obtained after deductions had been made for depreciation of 5 per cent. each year on the cost of the plant and distributing system, except for the last three years, when 2 per cent. and 3 per cent. were deducted.

Injury to Power-House Employee

The Massachusetts Supreme Judicial Court lately decided that a company operating a steam-power plant was not liable for injury to an employee, sustained under these circumstances: Near the power house was a pit partly filled with water, in which it was plaintiff employee's duty to dump ashes taken by him from the boilers. In tipping one lot of ashes into the pit, their heat in sudden contact with the water in the pit caused an explosion which threw steam and hot ashes against his face and eyes. He was previously familiar with all the surrounding conditions and had had similar experiences minus injury. The court finds that the company was not negligent in the method adopted in disposing of ashes, that appearing to conform to a common practice at steam-power plants; and that plaintiff assumed the risk of the accident, especially since he previously knew the result of casting hot ashes into the pit. It is further decided that the fact that there may have been a pipe under the boilers to cool and moisten the ashes before their removal, and that at the particular time no water was running through the pipe, did not show any such negligence toward plaintiff as entitles him to recover on account of his injury. (Mammott vs. Worcester Consolidated Street Railway Co., 117 Northeastern Reporter, 336.)

A new industrial town is being built at Glaamfjord, near Bodo, in Northern Norway where a water power of 150,000 hp. is being developed.—*Commerce Reports.*

Federal Fuel Administrators

So that *Power* readers may have the names and addresses of Federal fuel administrators in case they have occasion to appeal or complain to them about overcharge or other criminal irregularities, a complete list of administrators, furnished on request by the Fuel Administration at Washington, follows:

State	Name	Address	
Alabama	S. P. Kennedy	1130 Noble St	Anniston
Arizona	Will L. Clark	118 North Central Ave	Phoenix
Arkansas	H. C. Couch		Pine Bluff
California	Albert E. Schwabacher	611 Market St	San Francisco
Colorado	William J. Galligan	State Museum Bldg	Denver
Connecticut	Thomas W. Russell	State Capitol	Hartford
Delaware	Chas. H. Ten Weeges	145 Dupont Bldg	Wilmington
Dis. of Columbia	John L. Weaver	R. 927, Woodward Bldg	Washington
Florida	Arthur T. Williams		Jacksonville
Georgia	Dr. L. G. Hardman		Commerce
Idaho	Frank R. Gooding	First Nat'l Bank	Gooding
Illinois	John E. Williams	120 West Adams St	Chicago
Indiana	Evans Woollen	227 Federal Bldg	Indianapolis
Iowa	Charles Webster	State House	Des Moines
Kansas	Emerson Carey	Avenue B, East	Hutchinson
Kentucky	Wiley B. Bryan	Inter-Southern Bldg	Louisville
Louisiana	John G. O'Kelley	Canal Bank Annex	New Orleans
Maine	J. C. Hamlen	Masonic Bldg	Portland
Maryland	Ferdinand A. Meyer		Baltimore
Massachusetts	James J. Storrow	State House	Boston
Michigan	William K. Prudden	State House	Lansing
Minnesota	John F. McGee	New York Life Bldg	Minneapolis
Mississippi	C. L. Townes		Minter City
Missouri	Wallace Crossley	State Capitol	Jefferson City
Montana	W. J. Swindlehurst	State Capitol	Helena
Nebraska	John L. Kennedy	Saunders-Kennedy Bldg.	Omaha
Nevada	E. H. Walker	State Capitol	Carson City
New England	James J. Storrow	State House	Boston
New Hampshire	Charles M. Floyd	829 Elin St	Manchester
New Jersey	Richard C. Jenkinson		Newark
New Mexico	William C. McDonald		Carrizozo
New York	Albert H. Wiggin	61 Broadway	New York City
North Carolina	A. W. McAlister	Southern Life & Trust Co.	Greensboro
North Dakota	I. P. Baker	Bismarck Bank Bldg	Bismarck
Ohio	Homer H. Johnson	Wyandotte Bldg	Columbus
Oklahoma	P. A. Norris	101 East Main St	Ada
Oregon	Fred J. Holmes	Northwestern Bank Bldg.	Portland
Pennsylvania	William Potter	Room "E" Bellevue-Stratford	Philadelphia
Rhode Island	George H. Holmes	State House	Providence
South Carolina	B. B. Gossett	Anderson-Mattison Bldg.	Anderson
South Dakota	W. G. Bickelhaupt		Aberdeen
Tennessee	W. E. Myer	State Capitol	Nashville
Texas	Wiley Blair		Dallas
Utah	W. W. Armstrong	Box No. 1788	Salt Lake City
Vermont	H. J. M. Jones	State House	Montpelier
Virginia	Harry F. Byrd	Mutual Building	Richmond
Washington	David Whitcomb	4184 Arcade Bldg	Seattle
West Virginia	J. Walter Barnes	Municipal Bldg	Fairmont
Wisconsin	W. N. Fitzgerald	238 Wells Bldg	Milwaukee
Wyoming	Augustine Kendall		Rock Springs

Safe Speed for Cast-Iron Flywheels

The following table of safety speeds for cast-iron flywheels has been prepared by William H. Boehm and published in the *Operative Miller*. The margin of safety at the speed given is considered to be approximately three.

Diameter in Ft.	R.P.M.	R.P.M.	R.P.M.	R.P.M
1	1,910	955	1,350	1,480
2	955	408	675	740
3	637	318	450	493
4	478	239	338	370
5	382	191	270	296
6	318	159	225	247
7	273	136	193	212
8	239	119	169	185
9	212	106	150	164
10	191	96	135	148
11	174	87	123	135
12	159	80	113	124
13	147	73	104	114
14	136	68	96	106
15	128	64	90	99
16	120	60	84	92
17	112	56	79	87
18	106	53	75	82
19	100	50	71	78
20	95	48	68	74
21	91	46	65	70
22	87	44	62	67
23	84	42	59	64
24	80	40	56	62
25	76	38	54	59
26	74	37	52	57
27	71	35	50	55
28	68	34	48	53
29	66	33	47	51
30	64	32	45	49

If the revolutions given in the table be increased 20 per cent., the margin of safety on speed will be reduced to two and one-half; if the revolutions be increased 50 per cent., the margin of safety will be reduced to two.

Obituary

Joseph F. Chuse, founder and manager of the Chuse Engine and Manufacturing Co., Mattoon, Ill., died suddenly on Nov. 18. Mr. Chuse founded the business under the name of J. F. Chuse & Co. in 1875 and has seen it grow from a repair shop of two employees up to its present position. He was in active service as manager up to the time of his death.

Thomas Eugene Byrne, vice president and chief engineer of the Kings County Lighting Co., died at his residence, 51 Montgomery Place, Brooklyn, on Dec. 14, in his sixty-fifth year. Mr. Byrne entered the employ of the old Citizens' Gas Light Co. as a boy and in time became its chief engineer, holding that position until it was consolidated with the Brooklyn Union Gas Co., in 1895, when he became chief engineer of the combined companies. In 1900 he organized the Kings County Lighting Co., became its chief engineer and general manager and later was elected vice president, holding the three positions until the time of his death.

Personals

O. H. Skinner, formerly general superintendent of the Prest-O-Lite Co., Inc., Indianapolis, is now general superintendent and chief engineer.

Walter C. Allen, president of the Yale & Towne Manufacturing Co., has been commissioned as a major in the Signal Corps and will soon leave for France.

Edward T. Binns, formerly chief engineer of the Philadelphia Bureau of Charities, is now connected with the sales department of the Philadelphia office of the Keystone Lubricating Co.

Richard H. Rice, of the General Electric Co.'s steam-turbine engineering department, West Lynn, Mass., was recently elected president of the National Conference of State Manufacturers' Associations at Indianapolis, Ind.

Olaf E. Oleson, who was for years chief engineer of Stations One and Two of the Commonwealth Edison Co., Chicago, recently resigned to become president and general manager of the Edwards Valve and Manufacturing Co., of East Chicago, Ind.

A. D. Bailey, who has been assistant engineer of the Chicago Commonwealth Edison Co.'s Fisk Street and Quarry Street stations, Chicago, for the last eight years, has been appointed chief engineer of these two stations to succeed Olaf E. Oleson, resigned.

Joseph McKay, Jr., for 13 years with the Wheeler Condenser and Engineering Co., and for the last two years with the Pittsburgh Valve Foundry and Construction Co., is now general sales manager of the Deschangel Engineering Corp., 90 West St., New York.

Chas. A. Piez, president of the Link-Belt Co., of Chicago, who was recently appointed vice president of the Emergency Fleet Corporation, has been appointed general manager of the United States Shipping Board, to succeed Rear Admiral Frederick R. Harris, who will return to his former post as Chief of the Navy Bureau of Yards and Docks.

Hubert C. Verhey, who some time ago resigned his position as chief designing engineer for the marine Diesel engine department of Busch-Sulzer Brothers Diesel Engine Co., of St. Louis, to enter the consulting-engineering field on Diesel engines, is now chief draftsman of the Emergency Fleet Corp., at Washington, where he expects to eventually take charge of Diesel engine work.

Leonard S. Cairns, assistant general manager of the Manila Electric Railroad and Light Co., Manila, P. I., has been appointed general manager of the Eastern Pennsylvania Railways Co., Pottsville, Penn., by the J. G. White Management Corporation, New York City, the operating managers of both companies. Mr. Cairns has arrived in the United States and has assumed the duties of his new position. He succeeds L. H. Palmer, who lately became assistant to the president of the United Railways and Electric Co., Baltimore, Md. Mr. Cairns, upon leaving high school, entered the employ of the Twin City Rapid Transit Co., Minneapolis, Minn., and after several promotions, was made general superintendent of that company. In 1912 he was employed by the J. G. White Management Corporation to fill the position of assistant general manager of the Manila Electric Railroad and Light Company.

Robert K. Tomlin, Jr., sailed recently for France to serve "Power" and the other papers of the McGraw-Hill Publishing Co., Inc., as special correspondent at the front. Mr. Tomlin was graduated from Harvard University in 1907. During his college course he served for two summers as assistant in the surveying and railroad field engineering of the Harvard Engineering Camp at Squam Lake, N. H. After graduation he entered the employ of the Pennsylvania R.R. on the tunnel work in connection with the Pennsylvania Station in New York City. He left this work to go to the New York Board of Water Supply, and was stationed with the Northern Aqueduct Department at Poughkeepsie, N. Y. His journalistic experience dates from March, 1909, when he became assistant to the editor of the "Engineering Record." He was subsequently made associate editor, in charge of the municipal and sanitary field, and in 1913 was promoted to managing editor. When "Engineering News-Record" was formed last April by the consolidation of "Engineering News" and the "Engineering Record," Mr. Tomlin was made managing editor.

Engineering Affairs

The American Association for the Advancement of Science will hold its 70th meeting at Pittsburgh, Penn., Dec. 28, 1917, to Jan. 2, 1918, with headquarters in the main building of the Carnegie Institute.

The Philadelphia Section of The Association of Iron and Steel Electrical Engineers will hold a meeting on Jan. 5, at which J. C. Reed and Merwyn J. Hocker, electrical engineers of the Bethlehem Steel Co., will present an illustrated paper on "Electrically Operated Bridges."

The Brooklyn Engineers' Club held a beefsteak dinner on Thursday, Dec. 13, at its rooms, 117 Remsen St. Fully 150 members and guests enjoyed the good things to eat, drink and smoke. The entertainment was exceptionally good. The club will hold a smoker in the near future.

The Pittsburgh (Penn.) Section of the Association of Iron and Steel Electrical Engineers will hold a joint meeting with the American Institute of Electrical Engineers in January. Papers will be presented on Generation, Distribution and Consumption of Power, as well as Power Factor Correction.

The Consolidated Marine Engineers' Beneficial Association, No. 33, held its annual entertainment and ball at the Central Opera House, New York City, on Wednesday, Dec. 12. The large audience enjoyed a good vaudeville performance. There were present many prominent personages in the engineering field and officers of the Army and Navy. Dancing concluded an enjoyable night. The arrangement committee included F. J. Steele, James Moran, Thomas Healy, H. L. Jauss, Thomas Quigley, Richard Aiken, Thomas Delahunty and W. H. Meyers. Frank Martin was the floor director.

The New York Section of the American Society of Refrigerating Engineers will hold its annual meeting in New York Tuesday evening, Jan. 15, 1918, at the Machinery Club, 50 Church St., as heretofore. An interesting program is in preparation and a large attendance is anticipated. Technical refrigerating engineers, draftsmen, chief operating engineers and others interested in the art and science of refrigeration and allied industries are invited to attend and to become "affiliated members" of this section without being members of the American Society of Refrigerating Engineers. Address Charles H. Herter, Acting Secretary, 1912 Tribune Building, New York City.

New Jersey Association No. 1, N. A. S. E., held a house warming on Saturday, Dec. 15, to celebrate the opening of its new home in the Hofbrau Building at Five Corners, Jersey City. The new headquarters are centrally located and are easy of access from all parts of the city. An added interest to the occasion was the fact of its being the date of the State Visiting Committee. The attendance filled the spacious hall, among them being delegates from Phillipsburg, Hoboken, Perth Amboy and Elizabeth. There were several brief addresses, a good entertainment, and refreshments were liberally served. The committee in charge were Samuel Clark, Gus Krone, John Reddy and James Hughes. John J. Callahan was the master of ceremonies.

Miscellaneous News

The Lancaster Electric Light, Heat and Power Co.'s plant at Wabank, Penn., was destroyed by fire on the morning of Nov. 28, entailing a loss of nearly $150,000. Its origin is unknown.

William Nuss, a locomotive engineer at the Reliance Colliery, Shamokin, Penn., was fatally scalded on Dec. 10, while making repairs to his boiler. After drawing off the fire, he crawled into the firebox and was at work when the safety plug blew out. He was taken in a dying condition to the Miners' Hospital.

Pine Cones as Fuel—The "Schweizerische Bauzeitung" says that tests of pine cones as fuel have been made upon Swedish railroads, with results that have led to their growing use. Two tons of cones have about the same heating value as one ton of coal. In order to prevent their too rapid consumption, the cones are mixed with coal or coke.

A Nation-Wide Campaign for Economy in the use of coal among steam plants will be undertaken by the United States Fuel Administration. The campaign was determined upon following a conference of representatives of the Fuel Administration, the Bureau of Mines and the American Society of Mechanical Engineers held in New York. The intention is to provide for an inspection of steam plants and practical demonstrations in scientific firing that will afford higher efficiency and smaller consumption of coal. The educational campaign planned will be conducted by the Bureau of Mines, with the full backing of the Fuel Administration.

E. A. Klages, of the University of Pittsburgh, has finished a series of tests of strength of the weld in wrought-iron pipe for the A. M. Byers Co., of that city. Some one hundred and sixty pieces of pipe of various sizes, both butt and flat weld were tested, the pieces being placed with the welds at various angles to the vertically applied pressure. Only 20 pieces, or 12½ per cent., showed beginning of failure at the welds; 12 of the weld failures were in 24 pieces of 1-in. butt-welded pipe, and only 8 weld failures occurred in 136 pieces of lap-welded pipe of all sizes. Complete blueprint copies of the tests will be furnished free upon request to the A. M. Byers Co., Pittsburgh, Penn.

Business Items

Walter G. Ruggles Co., of Boston, Mass., changed its name on Dec. 1 and will hereafter be known as the Ruggles-Klingemann Manufacturing Co.

Nagle Corliss Engine Works, of Erie, Penn., has opened an office in the Bourse Building, Philadelphia. This gives direct representation and personal attention to all inquiry from that section.

The Graphic Colorplate Engraving Co., Inc., has taken over the plant and good will of the Thoma Engraving Co., and the combined outfit will hereafter be located at 137-139 West 38th St., New York.

H. D. Payne has opened an office in the Havemeyer Building, 25 Church St., New York City, as an electric-crane specialist, supplying new and used traveling cranes of certified character. Mr. Payne was formerly associated with Manning, Maxwell & Moore, Inc., New York, and has had an extensive experience in this kind of work.

The Economy Fuse and Manufacturing Co., of Chicago, has purchased the entire fuse business of the Detroit Fuse Manufacturing Co., maker of the "Arkless" inclosed fuses. The transaction includes the conveyance of all merchandise, material, machinery, tools, designs, patents, good will and unfilled orders. Owing to arrangements made well in advance, there will be no interference with deliveries of either "Arkless" or "Economy" fuses. The "Square D" line of inclosed safety switches remains the property of the Detroit Fuse Manufacturing Co., which will concentrate on its production and marketing.

THE COAL MARKET

Boston—Current quotations per gross ton delivered alongside Boston points as compared with a year ago are as follows:

ANTHRACITE

	Circular[1]		Individual[1]	
	Dec. 21, 1917	One Year Ago	Dec. 21, 1917	One Year Ago
Buckwheat ..	$4.60	$2.05—3.20	$7.10—7.35	$3.25—3.50
Rice	4.10	2.50—2.65	6.65—6.90	2.70—2.95
Boiler	3.90	.....	.....	.....
Barley	3.60	2.20—2.35	6.15—6.40	2.35—2.60

BITUMINOUS

Prices per gross ton for Boston delivery are as follows:

	F.o.b. Mines*		Alongside Boston†	
	Dec. 21, 1917	One Year Ago	Dec. 21, 1917	One Year Ago
Clearfields....	.....	$3.00	.....	$4.25—5.00
Cambrias and Somersets...	.....	3.10—3.85	.....	4.60—5.40

Note—Bituminous not on market.
Pocahontas and New River, f.o.b. Hampton Roads, is $4, as compared with $2.85—2.90 a year ago.
*All-rail rate to Boston is $2.69. †Water coal.

New York—Current quotations per gross ton f.o.b. Tidewater at the lower ports* as compared with a year ago are as follows:

ANTHRACITE

	Circular[1]		Individual[1]	
	Dec. 21, 1917	One Year Ago	Dec. 21, 1917	One Year Ago
Pea	$5.05	$4.00	$5.80	$5.50—5.60
Buckwheat ..	4.30—5.00	2.75	5.75—6.00	4.75—5.00
Rice	3.75—3.95	2.20	4.75—5.00	3.00—3.25
Barley	3.25—3.50	1.95	3.70—3.95	2.25—2.50
Boiler	3.50—3.75	2.20	.....	.....

Bituminous smithing coal, $4.50—5.25 f.o.b.
Quotations at the upper ports are about 5c. higher.

BITUMINOUS

	F.o.b. N. Y. Harbor	Mine
Pennsylvania	$3.65	$2.00
Maryland	3.65	2.00
West Virginia (short rate).....	3.65	2.00

Based on Government price of $2 per ton at mine.

*The lower ports are: Elizabethport, Port Johnson, Port Reading, Perth Amboy and South Amboy. The upper ports are: Port Liberty, Hoboken, Weehawken, Edgewater or Cliffside and Guttenberg. St. George is in between and sometimes a special boat rate is made. Some bituminous is shipped from Port Liberty. The freight rate to the upper ports is 5c. higher than to the lower ports.

Philadelphia—Prices per gross ton f.o.b. cars at mines for line shipment and f.o.b. Port Richmond for tide shipment are as follows:

	Line		Tide		Independent
	Dec. 21, 1917	1 Yr. Ago	Dec. 21, 1917	1 Yr. Ago	Dec. 21, 1917
Buckwheat ..	$3.15	$2.00	$3.75	$2.90	$4.15
Rice	2.65	1.25	3.65	2.15	3.35
Boiler	2.45	1.10	3.55	2.00	....
Barley	2.15	1.00	2.40	1.90	2.35
Pea	3.75	2.80	4.65	3.70	....
Culm	....	....	....	....	1.25

Chicago—Steam coal prices f.o.b. mines:

Illinois Coals	Southern Illinois	Northern Illinois
Prepared sizes	$2.65—2.80	$3.10—3.25
Mine-run	2.40—2.55	2.85—3.00
Screenings	2.15—2.30	2.60—2.75

Smokeless Coals	So. Illinois, Pocahontas, Pennsylvania and West Virginia	Hocking, East Kentucky and West Virginia Splint
Prepared sizes	$2.60—2.80	$3.05—3.25
Mine-run	2.40—2.60	2.40—2.60
Screenings	2.10—2.30	2.10—2.30

St. Louis—Prices pet net ton f.o.b. mines a year ago as compared with today are as follows:

	Williamson and Franklin Counties		Mt. Olive and Staunton		Standard	
	Dec. 21, 1917	One Year Ago	Dec. 21, 1917	One Year Ago	Dec. 21, 1917	One Year Ago
6-in. lump..	$2.80	$3.00	$2.80	$2.60	$2.80	$2.25–2.50
2-in. lump..	2.80	....	2.80	....	2.80	2.00–2.25
Steam egg...	2.80	3.00	2.80	....	2.80	2.00–2.25
Mine-run ...	2.55	2.75	2.55	2.60	2.55	2.00–2.25
No. 1 nut...	2.80	3.00	2.80	2.50	2.80	2.00–2.25
2-in. screen.	2.30	2.75	2.30	2.50	2.30	2.00–2.25
No. 5 washed	2.30	2.75	2.30	2.75	2.30	2.00–2.25

Williamson-Franklin rate St. Louis, 87½c.; other rates, 72½c.

Birmingham—Current prices per net ton f.o.b. mines are as follows:

	Mine-Run	Lump and Nut	Slack and Screenings
Big Seam	$1.90	$2.15	$1.65
Pratt, Jagger, Corona....	2.15	2.40	1.90
Black Creek, Cahaba ...	2.40	2.65	2.15

Government figures.

[1]Individual prices are the company circulars at which coal is sold to regular customers irrespective of market conditions. Circular prices are generally the same at the same periods of the year and are fixed according to a regular schedule.

PROPOSED CONSTRUCTION

Ariz., Bisbee—City plans election to vote on $375,000 bond issue for the erection of an electric-lighting, gas and water system

Calif., Escondido—San Diego Consolidated Gas and Electric Co. is having plans prepared for the erection of a three-phase electric transmission line into the San Pasqual Valley. R. L. Clarke, San Diego, Gen. Supt.

Calif., Oroville—The Great Western Power Co., 14 Sansom St., San Francisco, has purchased a site of land consisting of 1255 acres on the Feather River, and plans to build a power plant. Estimated cost, $6,000,000. E. W. Beardsley, San Francisco, Gen. Supt.

Calif., Santa Rosa—The California Telephone and Light Co has petitioned the State R.R. Commission for permission to run a transmission line to Summer Home Park and vicinity in Sonoma County. O. R. Evans, Gen. Supt.

D. C., Wash.—(Offical)—Bureau of Supplies and Accounts, Navy Dept., Wash., will soon receive bids for furnishing at various Navy Yards, under Schedule No. 1637; 70,000 sq.ft. high-pressure insulating blocks, magnesa blocks, 125,000 lb. plastic magnesia cement, magnesia pipe covering, asbestos fiber felting, 572,300 lb. asbestos millboard, 35,850 lb. wick or rope asbestos packing, 55,700 lb. of 36 in. asbestos paper, 326,000 lb. asbestos plaster for pipe covering and flexible voice tubing; furnishing at Navy Yard, Wash., D. C., under Schedule No. 1636, galvanized and black ells, tees, iron pipe fittings, cast-iron soil pipe, and hot water rococo radiators.

Idaho, Hailey—At a recent election City defeated a $90,000 bond issue for the erection of an electric-lighting plant. Noted Oct. 30.

Md., Trappe—F. Baker and H. A. Nevuis are interested in the construction of an electric-lighting plant here.

Mass., Boston—(Offical)—Bureau of Supplies and Accounts, Navy Dept., Wash., will soon receive bids for furnishing at Navy Yard, Boston, under Schedule No. 1627, lead pipe and lead lining for pipe.

Mo., St. Joseph—City plans to improve its electric-lighting plant. Estimated cost, $31,000. H. Judson, City Engr.

Neb., Falls City—City Council has under consideration plans for the remodeling of the electric-lighting plant. An election will soon be called to vote on $75,000 bonds for project.

N. J., Matawan—The Borough Council plans to install electrically driven machinery throughout its pumping plant.

Okla., Woodward—City plans an election to vote on $20,000 bond issue for the erecton of an electric-lighting plant.

Ore., Bend—The Deschutes White Pine Lumber Co. plans to build a hydro-electric power plant in connection with its new sawmill now being constructed.

Ore., Portland—The Commission of Public Docks has authorized A. Hegardt, Ch. Engr., to purchase equipment including motors and transformers for the St. Johns Terminal project.

Penn., Chambersburg—J. H. Mowery, Manager of the Board of Utilities, has petitioned the City Council for permission to appropriate $60,000 for machinery in the electric-lighting plant, including a 1000-kw. generator.

Penn., Lancaster—The Lancaster County Ry. and Light Co. has purchased the property of the Lancaster Electric Light, Heat and Power Co. and plans to rebuild the latter's plant at Wabank which was destroyed by fire. Loss, $15,000. W. W. Griest, Pres.

Penn., Lansdowne—The Delaware County Electric Co., 1000 Chestnut St., Philadelphia, has issued $2,693,800 in bonds; the proceeds to be used for additions and improvements. A. R. Granger, Chester, Mgr.

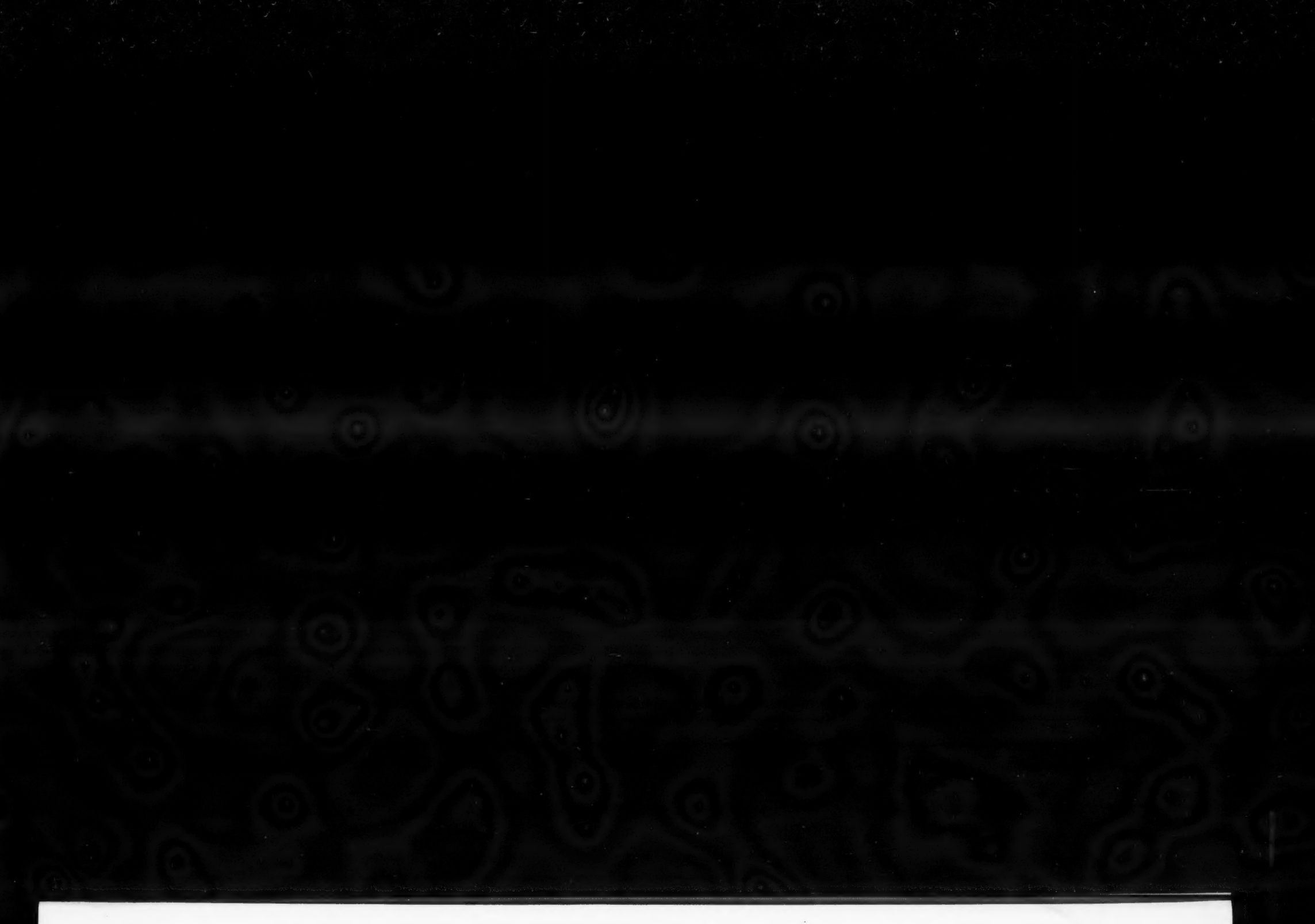
Penn., Philadelphia—The American International Shipbuilding Corporation acquired a site of land beginning at Alburger Lane and will build a high-tension transmission line to the Hog Island shipyard.

Penn., Pittsburgh—The Consolidated Traction Co., Philadelphia, has filed notice with the Public Service Commission of the issuance of $200,000 bonds; the proceeds will be used to improve its system. F. Uhlenhart, Jr., 435 6th Ave., Philadelphia, Ch. Engr.

Penn., Pottsville—C. A. Faust, Supt. of the Schuylkill Haven Light Dept., will receive bids until Dec. 27 for the erection of a boiler house in addition to the electric-lighting plant.

Penn., Roaring Springs—The Roaring Springs Light and Power Co. has increased its capital stock by an additional $50,000; the proceeds will be used for addtions and improvements.

Penn., Scott Haven—The Scott Haven Light Co. is having plans prepared by W. H. Hill, Arch., Pottsville, for the erection of a new 1-story, 40 x 50-ft. power house.

Penn., Tacony (Philadelphia P.O.)—The Tacony Ordnance Co. plans to erect a new 1-story, 45 x 50-ft. power plant here. Estimated cost, $12,000.

Tex., Nacogdoches—The City Council plans to install a large amount of new machinery and equipment in the electric-lighting plant.